Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

No. 186

IMMEDIATE DELIVERY

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DETROIT

COLOUR BY

Courtaulds
LIMITED

CELLULOSE ACETATE MOULDING POWDER

EXTRUDED PRODUCTS

TRANSPARENT FILM

PLASTICS DIVISION: Little Heath, Coventry. Tele: Coventry 88031. 16 *St. Martins-le-Grand, London, E.C.*1. *Tele: Monarch* 8811

VELBEX

BX CALENDERED & EMBOSSED P.V.C. SHEET

MADE ONLY BY BX PLASTICS

BX PLASTICS LTD. Higham Station Avenue, London, E.4. Larkswood 551

They're lively lads at Lorival

U34

This Cheese Core Sleeve (for textile winding) requires grooving on the outside and an undercut recess half-way down the bore, yet must be completely free of flash or burrs. A transfer injection moulding held to close limits of tolerance solved both these problems.

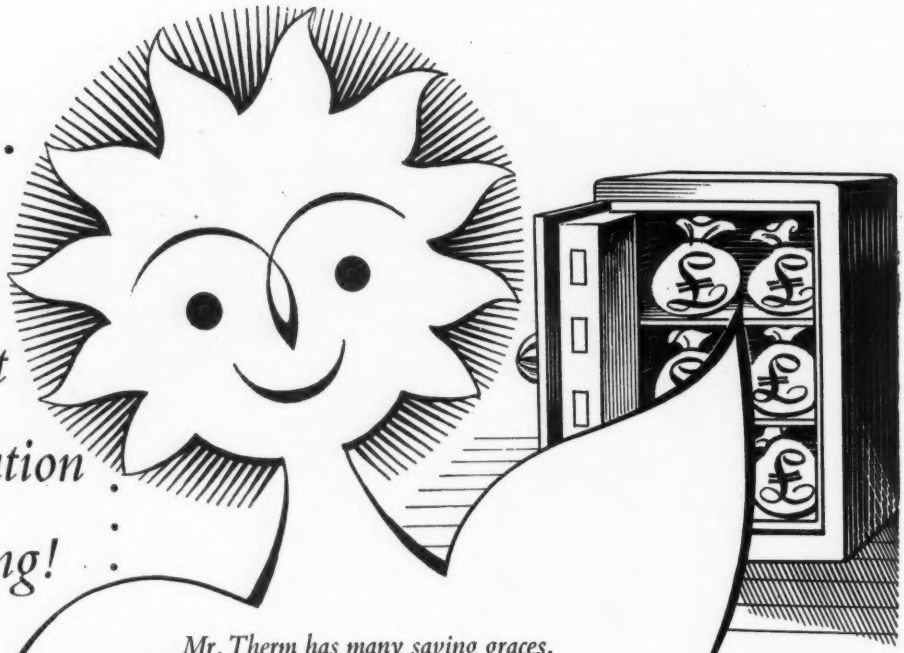
Our proposition, sir, is surprisingly simple. It is this! You can't be a master of every technique. Therefore, where mouldings in plastics are concerned—leave it to Lorival. They're lively lads at Lorival! They'll give you a first-rate service: pleasing design, fine finish, keen prices, and rapid delivery. What more could you want!

LORIVAL PLASTICS

UNITED EBONITE & LORIVAL LTD · LITTLE LEVER · NR. BOLTON · LANCS.

A

I've got the right combination for saving!



Mr. Therm has many saving graces. With gas and gas equipment he lets you tap the exact amount of fuel you need (without waste) for a thousand different jobs. To expand his economy Mr. Therm adds a further combination of virtues: flexibility of use; accuracy of self-adjustment; rigid control of fuel consumption; speed in reaching working temperatures; cleanliness of operation. In fact, Mr. Therm is so versatile that he can usually be found helping wherever people work.

Mr. Therm burns to serve you

THE GAS COUNCIL · 1 GROSVENOR PLACE · LONDON · SW1

Mr. THERM HELPS IN PLASTICS MANUFACTURE
He makes himself very useful in platen heating, heating mixing machines and moulds, pre-heating powders before moulding and the curing of vulcanised products.

"This nylon gear is quite remarkable, Mr. Ash!"

"It's jolly tough stuff, too, Mr. Downs."

"It has to be, Mr. Ash. When our customer wanted a pair of bevel gears for a food mixing machine we knew that we would have to mould to very close tolerances . . ."

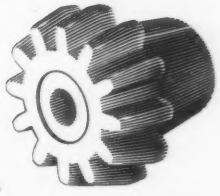
"It had to be very clean and hygienic, too, I suppose, Mr. Downs."

"It did, Mr. Ash, By moulding in nylon plastic we knew that it would take a great deal of strain, that it would practically never wear out and although it is so light in weight it would remain free from distortion or cracking."

"Wonderful stuff, Mr. Downs. It just shows that . . .

If you want to know what plastics can do for you

ask Ashdowns

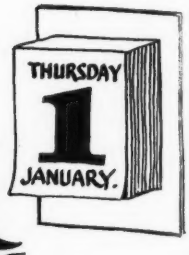


Nylon bevel gear for a food mixer

ASHDOWNS LIMITED, ECCLESTON WORKS, ST. HELENS, LANCS. Phone: St. Helens 3206

Ashdowns Ltd. is a subsidiary of Pilkington Brothers Ltd.

NEW YEAR RESOLUTION



Entrust your moulding problems to a firm with over 30 years' experience in the plastics industry

- DESIGN
- TOOLMAKING
- COMPRESSION, INJECTION and TRANSFER MOULDING
- ENGRAVING
- COLOUR BLOCKING of MOULDINGS
- ASSEMBLIES
- SERVICE

W. W. BALL & SONS LTD

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HYDROQUINONE

M&B

AND DERIVATIVES

—a valuable range of raw materials for industrial use as antioxidants, stabilizers, and inhibitors. The **M&B** hydroquinone plant at Dagenham is the largest and most up-to-date of its kind in Europe.

Enquiries for these and other hydroquinone derivatives will be welcomed:

HYDROQUINONE
MONOMETHYL HYDROQUINONE
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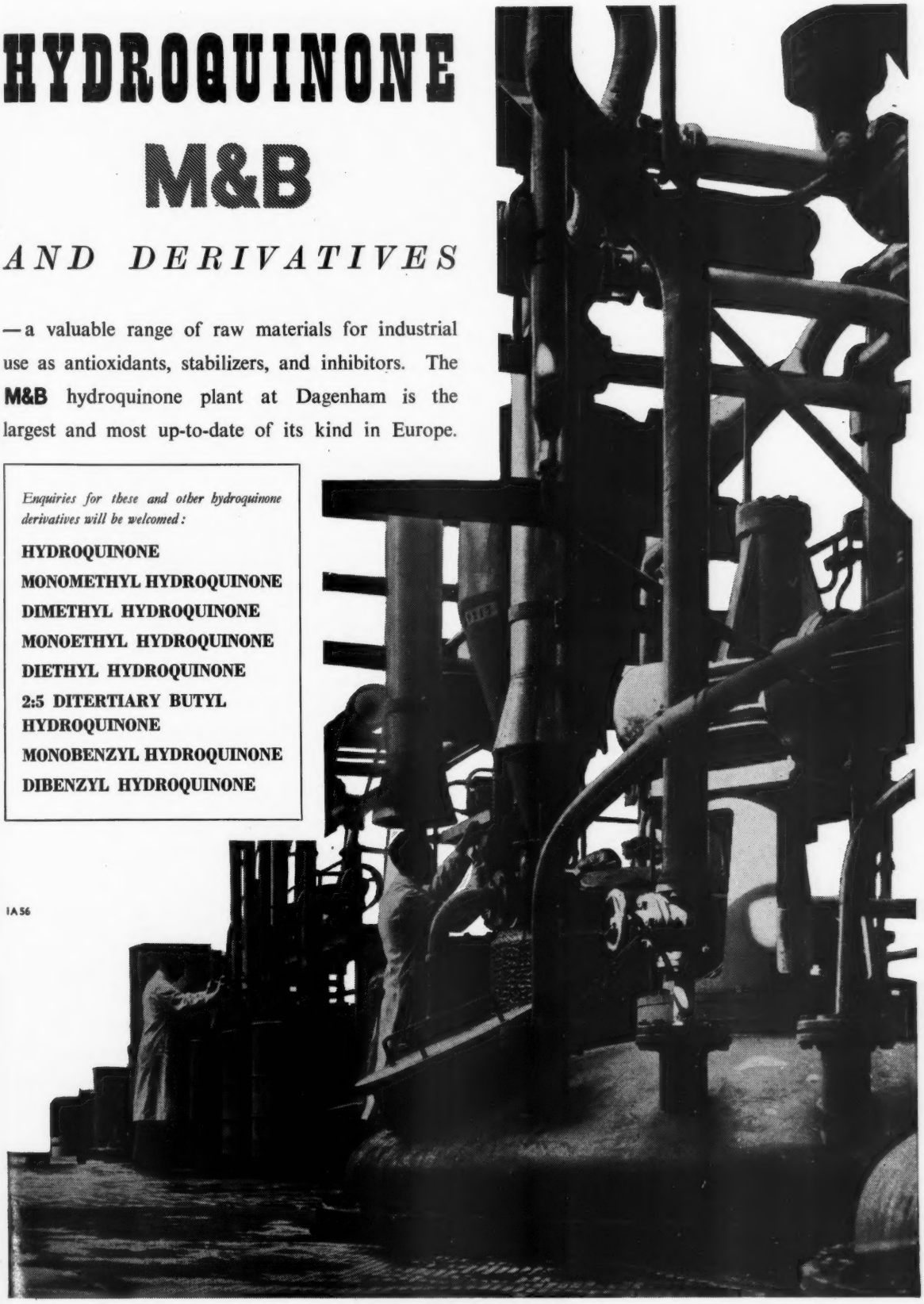
2:5 DITERTIARY BUTYL HYDROQUINONE
MONOBENZYL HYDROQUINONE
DIBENZYL HYDROQUINONE



1A56

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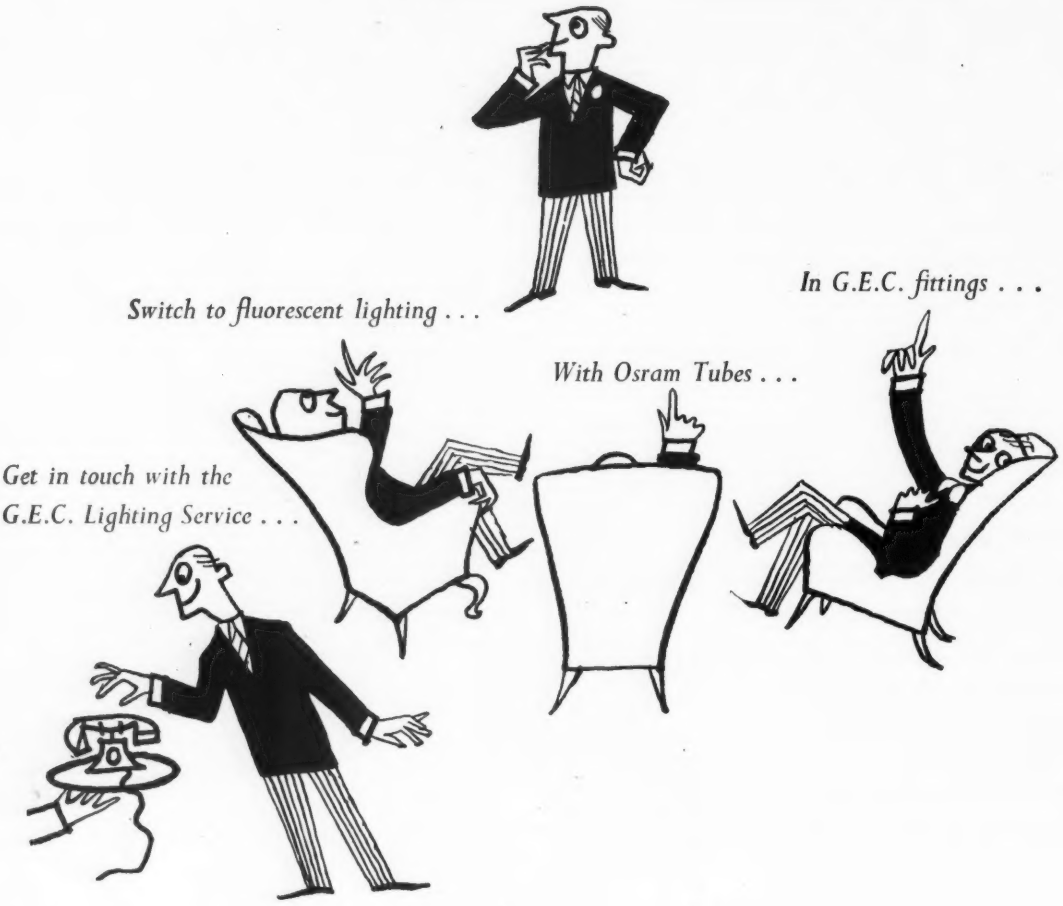


Fluorescent lighting?

Is your lighting really effective and economical? For instance, a modern fluorescent installation would cut your consumption of current by over half, for the same amount of light as you are now getting. Alternatively, you could have over double the light at no extra cost! The people to guide you are the G.E.C., pioneers of fluorescent lighting and the first to establish an Advisory Lighting Service with every technical help on call. Gentlemen, you'll save a lot of talk . . . if you see the G.E.C. first.

Osram

tubes in G.E.C. fittings

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

NEW 'OILSKINS' FOR THE BRITISH NAVY

made with PVC treated fabrics

"... Foul weather clothing has been under review for some time and a range has been devised to meet requirements both in temperate and cold climates. Oilskin garments will eventually give way to those made from fabrics impregnated with PVC ..."

This Admiralty statement indicates the extent to which PVC treated fabrics are replacing conventional oilskin. Among the first to recognise the advantages were Edward Macbean & Co. Ltd. who, after exhaustive tests, produced the MAXRON range of weatherproof clothing. Impregnated and coated with Geon PVC, this lightweight material withstands ocean storms, prolonged exposure to fierce sun and arctic frost, tearing, abrasion, oil and flame—*and can be stored away wet without deterioration*—a truly remarkable combination of properties conferred by Geon PVC!

Please write for Booklet No. 51 describing the Geon range of PVC raw materials.

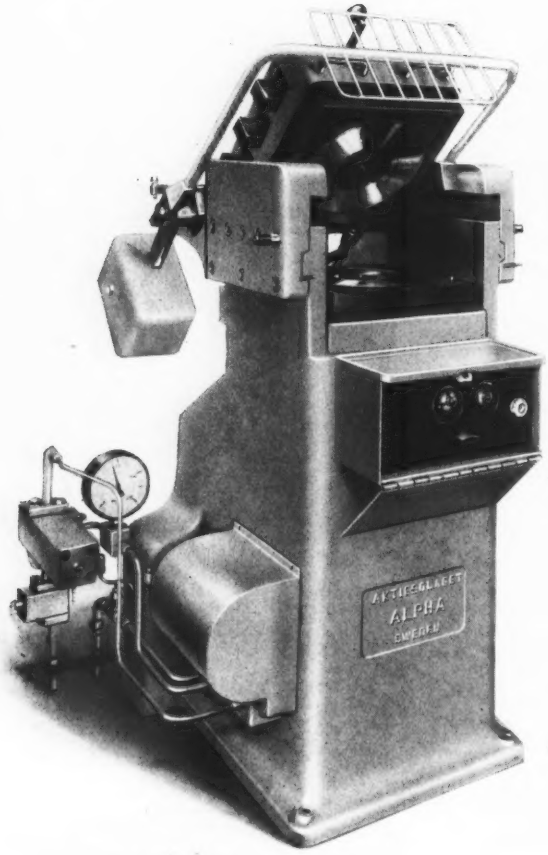
Geon
Polyvinyl Materials

BRITISH GEON LIMITED

Sales and Technical Service: 21 St. James's Sq · London S.W.1 · Tel: Whitehall 9561

"Geon" is a Registered Trade Mark

Vinyl as easy as shellac !



Type 7H 537

Is it possible to make LP-records as easily as shellac-records?

Yes, the special features of the Alpha semi-automatic record press make it possible:

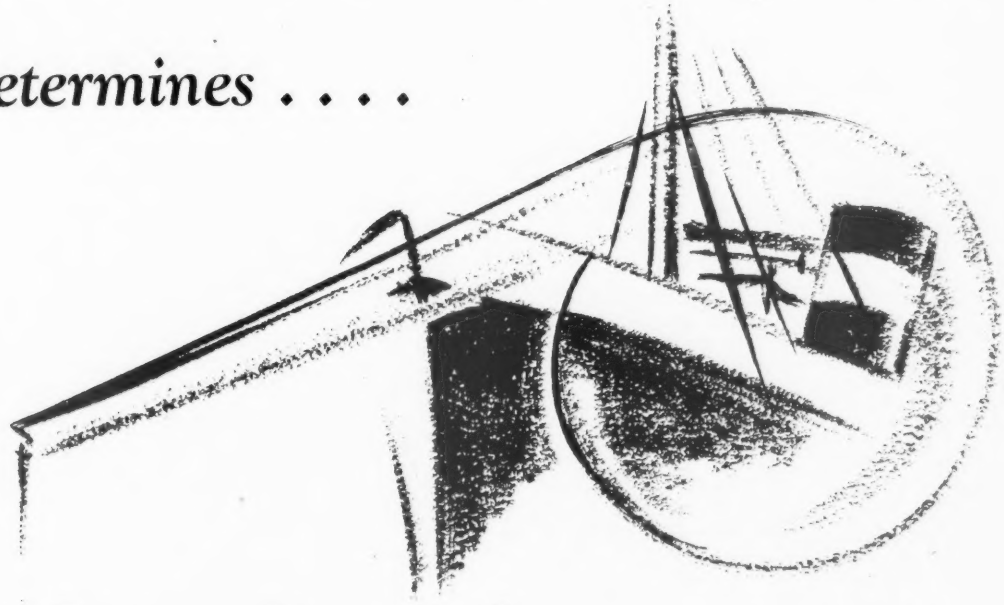
- Reliable electric automatic control of cycle.
- Timers give exact control of heat and pressure as well as cooling time.
- Timers can be adjusted in a moment to any setting desired.
- Easily changed from shellac to vinyl and vice versa.
- Capacity adjustable from 100 tons downward.
- Safety guard starts the press, giving complete safety.
- Unskilled labour can work the press.
- High-speed production.

AKTIEBOLAGET ALPHA

SUNDBYBERG, SWEDEN

Telegrams: "AKTIEALPHA"

The quality of the raw material determines . . . .



the quality of the finished product

Every shipment of raw material that we supply to the world's plastics industry is destined to be formed into products each with its own inherent properties of density, hardness, flexibility, texture, colour and so on.

E.A.P. materials are produced under rigid laboratory control to ensure that they embody the exact properties necessary for the production of finished products that are, within the limits of human endeavour, perfect.

EAP

The E.A.P. Technical Advice Service exists to help you with problems of flow, colour and grade of materials in relation to your particular production requirements.

suppliers of materials to the world's plastics industry

All enquiries for Cellulose Acetate, Polystyrene, Polyvinyl Chloride *to be addressed to*

EAST ANGLIA PLASTICS LTD

52 BROOK STREET, LONDON, W.1

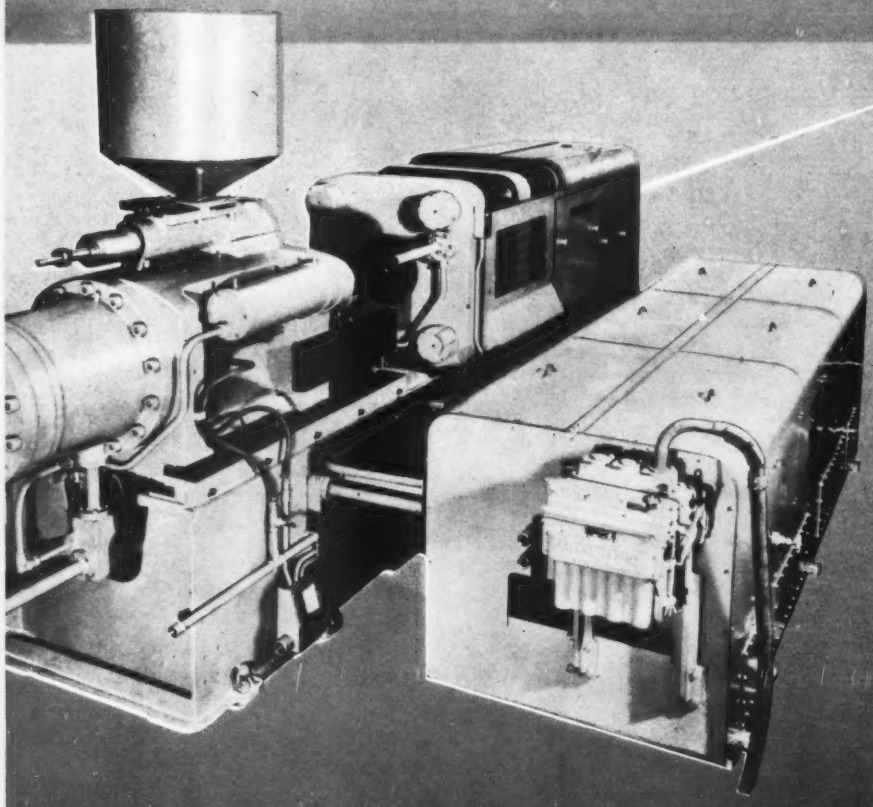
Telephone : MAYfair 4823 & 1973 *Telegrams : EANPLAST LONDON*

B

from all points of view

PECO Injection Moulding Machines have been designed to meet manufacturers' requirements in every particular. They supply at maximum speed a flow of precision mouldings, whether simple or intricate, with the minimum of labour, both in operation and maintenance.

Their construction embodies various distinctive features—all contributing to the unsurpassed efficiency of the Peco models. Among these is the hydraulic operating gear on the Peco 16 oz. machine which is built (as illustrated) as a separate unit so that maintenance is easy and is effected with a minimum of time.



PECO Injection Moulding Machines cover a range from 2 to 16 oz. capacity. They are self-contained with automatic cycle. They have a high plasticising capacity and rate of injection; mould locking pressure and platen area enable them to operate at a high rate of production.

MOULDS. Expert designers and mould makers are employed and moulds can be supplied to samples submitted including die-sinking models if required. The plant includes a 3,000-ton hobbing press for the hobbing of cavities for moulds and medallions.

Full particulars of the PECO range of Injection Moulding Machines and Moulds will be sent on request.

The PROJECTILE & ENGINEERING COMPANY LTD.

PECO PRODUCTS

ACRE STREET, BATTERSEA, LONDON, S.W.8

Telephone: Macaulay 1212 Telegrams: "Projectus, Vesper, London" Cables: Projectus, London

ITALY

Exclusive Agencies Required

Large and well-established Italian house who are already agents for one of the largest British chemical concerns, are prepared to accept further agencies for Italy in the plastics and allied fields.

THE ADVERTISERS REQUIRE TO WORK ON THEIR OWN ACCOUNT NOT ON A COMMISSION BASIS AND WOULD PURCHASE IMMEDIATELY ADEQUATE STOCKS.

Full sales organisation in operation covers the following industries :—

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Etc.

To speed negotiations replies to this advertisement will be dealt with initially by the Company's English correspondent in the strictest confidence.

Replies to **Box No. P861 c/o "Plastics"**
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LONDON, E.C.1

KLEESTRON

the *VERSATILE* plastic

NO need to state the virtues of polystyrene.
It is accepted all over the world for its versatility . . .
its adaptability. At long last the designer has been given
a moulding powder reasonably free from limitations.
No need either to state the virtues of Kleestron.
Enough to say it is made by Kleemann's
in their new factory at Welwyn Garden City
and is being sold . . . and moulded . . .
and praised all over the world.

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UNIVERSAL METAL PRODUCTS LIMITED
PLASTICS DIVISION · SALFORD 6, LANCS

for

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THE SIGN OF SERVICE
AND CO-OPERATION

Be sure to ask Crystalate to quote

for :-

MOULDINGS IN PLASTICS BY COMPRESSION TRANSFER AND INJECTION TO YOUR REQUIREMENTS

INSULATING HANDLES, BUSHES, CONTROL KNOBS, AND TERMINALS FROM STOCK MOULDS.

And Mica Products Ltd

for :-

INJECTION MOULDINGS IN THERMOPLASTICS

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BUSINESS ESTABLISHED 1899.

Alcohols *for plasticiser manufacture*

ALPHANOL 79
A mixture of C_7-C_9 primary alcohols with a mean molecular weight of approximateiy 125
NONANOL
Consists essentially of 3, 5, 5-trimethylhexanol-1 with a mean molecular weight of approximately 144

Esters based on these alcohols are excellent plasticisers for PVC and give exceptional flexibility, outstanding low temperature characteristics, and high stability. Samples of phthalate and sebacate esters may be obtained from the plasticiser manufacturers. Further information on these and other applications, including surface coatings, may be had from

Shell Chemicals Limited
(DISTRIBUTORS)

Norman House, 105-109 Strand, London, W.C.2.

SHELL

"ALPHANOL" is a Registered Trade Mark

Air conditioning for car body spraying at Messrs. Fisher & Ludlow Ltd., Erdington

Does air conditioning affect output?

IN VERY MANY TRADES it does. Where consistent quality depends on constant temperature and humidity, air conditioning is the only way to ensure a low rejection rate. In others, where fumes or dust can mar the work, conditioned air is sometimes essential, and often desirable. Modern air conditioning plant provides predetermined air conditions in large or small spaces and is fully automatic. It is one more example of electricity used efficiently to maintain the level of production.

WHERE TO GET MORE INFORMATION

Your Electricity Board will be glad to help you to get the utmost value from the available power supply. They can advise you on ways to increase production by using Electricity to greater advantage — on methods which may save time and money, materials and coal, and help to reduce load shedding. Ask your Electricity Board for advice : it is at your disposal at any time.

Electricity for PRODUCTIVITY

Issued by the British Electrical Development Association

For Production of

Thermo Plastic Mouldings

From **12** ounces-
to **60** ounces

REFRIGERATOR DRAWER
—650 cubic inches. An example of one of our latest transparent mouldings, typical of the increasing use of thermoplastics for refrigerators.

in a BIG way

—BOTH IN SIZE AND QUANTITY

Clifford presses are as large as any in the country. Clifford capacity enables rapid, large-scale production to be maintained. Clifford experience in Thermoplastic Technology provides the answer to many moulding problems. Clifford experts are ready to advise you on latest developments or special requirements. Contact Clifford now!

CLIFFORD MOULDINGS & CASTINGS CO

(Proprietors: Clifford Covering Co. Ltd., a member of the Clifford Group of Companies)

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HUPFIELD Plastics

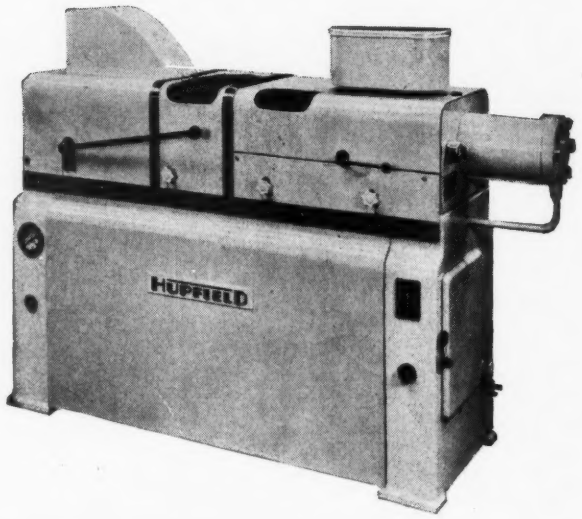
INJECTION MOULDING MACHINES

1 & 2 OUNCE CAPACITY

1953 MODELS

Single lever operated, semi-automatic, hydraulic machine, completely self-contained with electric motor. Fitted with a compensating feed mechanism and the latest Tem-Con automatic temperature control. The machine is economical to run and extremely simple to operate, ideal for female labour. All parts are standardised.

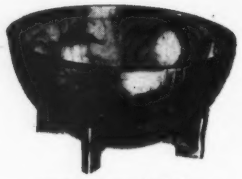
	1 oz.	2 oz.
Mould area approximately..	12 sq. in.	22 sq. in.
Plasticizing capacity per hour	11 lb.	22 lb.
Injection pressure	5½ tons	11 tons
Mould locking pressure ..	22 tons	44 tons
Shots per hour, subject to mould design	350	250



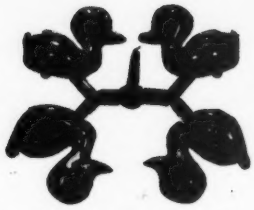
GRANULATING MACHINES

Granulates all thermoplastic materials, delivers at the rate of 80 lb. per hour. Cutting blades are adjustable and easy to clean. Completely self-contained with 2 h.p. electric motor.

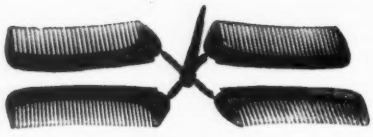
Mouldings from our 1 ounce machine



polystyrene 3¾" dia.
25 seconds. 1 ounce.



cellulose acetate 5½" × 5"
30 seconds. 31 gramme.



polystyrene 8" × 3¼"
20 seconds. 24 gramme

Write for particulars, or telephone our Works (Wordsworth 4488) for a demonstration.

HUPFIELD BROTHERS LIMITED WORKS AND OFFICES

DALSTON GARDENS · STANMORE · MIDDLESEX · ENGLAND

BACKGROUND TO I.C.I. PLASTICS

Production for World Markets

Keeping pace with the world demand for plastics, I.C.I.'s modern plants produce a wider range of plastic material than that of any other manufacturer.

This Banbury mixer is part of the polyvinyl chloride plant at the I.C.I. Plastics Division Hillhouse Works at Fleetwood, Lancashire.

● *P.V.C. polymer and plasticised P.V.C. compound are sold under the registered trade names 'CORVIC' and 'WELVIC'*

IMPERIAL CHEMICAL INDUSTRIES LTD., LONDON, S.W.1

Export enquiries should be addressed to:

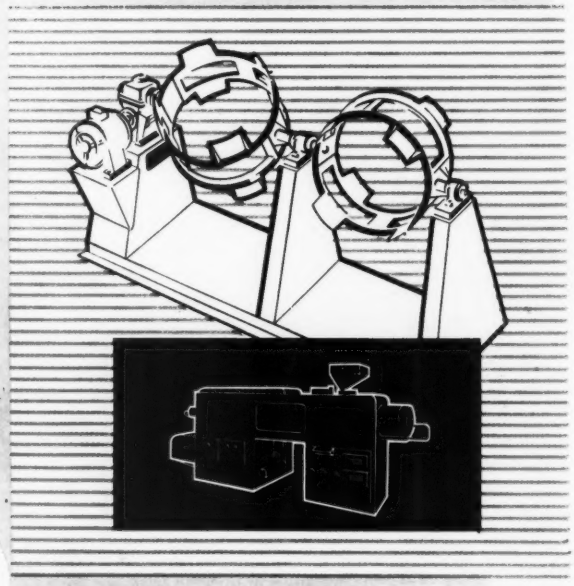
IMPERIAL CHEMICAL INDUSTRIES LTD.,
Plastics Division,
Black Fan Road, Welwyn Garden City, Herts., England

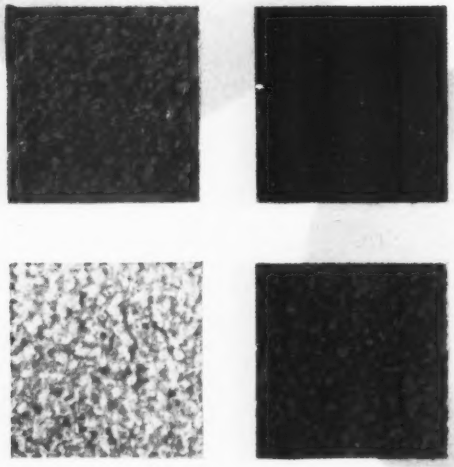
P.510

D

DRY BLENDING DISTRENE COLOURANT CRYSTAL WITH DYESTUFFS

"DISTRENE" Colourant Crystal enables moulders to produce their own polystyrene colours by a simple dry-mixing process. Among the advantages offered by the dry-colouring process are lower cost, reduced material stocks and the quick availability of standard and non-standard colours. "Distrene" Colourant Crystal is supplied in a special form to give maximum dispersion and needs only inexpensive tumbling or mixing equipment. Full technical information on this material and the simple techniques involved will be supplied on request. Ask for Technical Bulletin No. 3.





BRITISH RESIN PRODUCTS LIMITED

SALES & TECHNICAL SERVICE:
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TELEPHONE: WHITEHALL 8021

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FOR ELECTRICAL INSTALLATIONS

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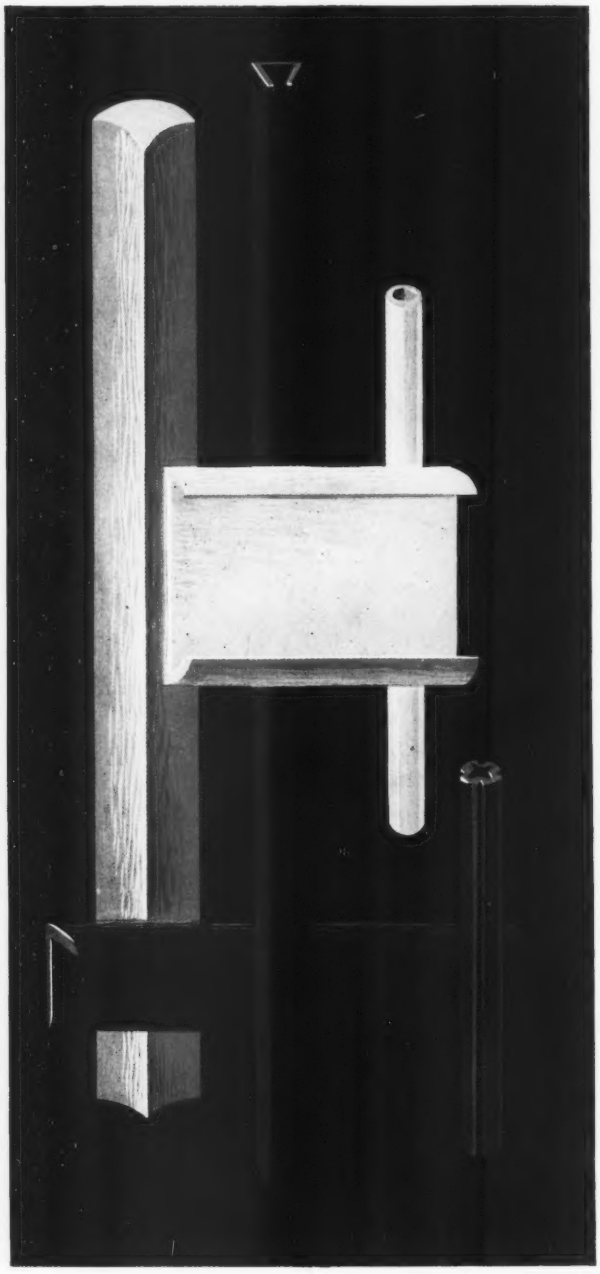

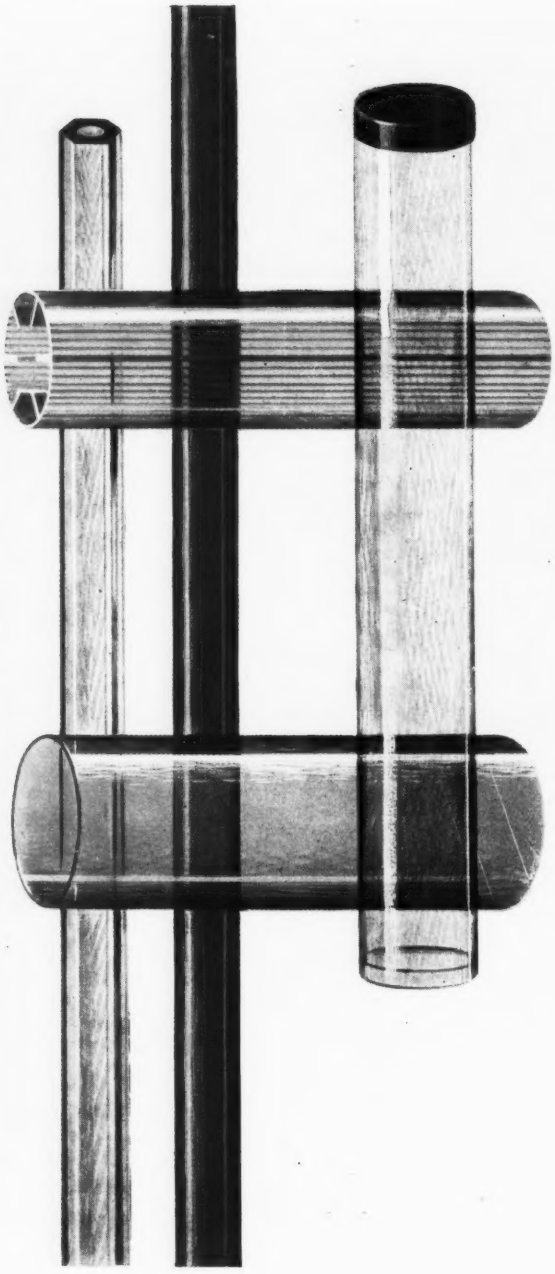

OPACITY OR TRANSPARENCY + COLOUR

Tell us precisely what you want in an Extrusion—how opaque or transparent, how rigid or flexible : give us an exact brief about profile ; nail us down on colour. You'll find we have a way of coming up with just the right answer —not to mention saving you metal, machining and money. Everyone has a job that a De La Rue Extrusion could do—what's yours?

★*In Cellulose Acetate, Polythene, Polystyrene, P.V.C. Rigid and Flexible, Cellulose Acetate Butyrate.*

EXTRUSIONS
DE LA RUE

THOMAS DE LA RUE & CO. LTD. *(Plastics Group)*, IMPERIAL HOUSE, REGENT STREET, LONDON, W.I. TEL: REGENT 2901

NESTORITE **GRADE A.645/693**

HIGH SHOCK

Filler	Cotton
Particle Size (inches)	1—2 flake
Specific Gravity	1·38
Bulk Factor	10—15
Powder Density	·09—·13
Time of Cure of Test Cup (secs.)	80—100
Recommended Flow Range	10—15
Shrinkage (thou./inch)	4·0—6·0
Flowability (cm.)	5—8
Impact Strength (ft./lb.)	·75—1·10
Tensile Strength (lb./sq. in.)	5,000—7,000
Water Absorption (7 days) (mg.)	200—300
Plastic Yield Grading (°C.)	140
Shrinkage after Heating 5" disc for 24 hrs. at 140°C. (thou./in.)	3·5
Electric Strength at 90°C. minute value (V/mil.)	15—50
Surface Resistivity after Immersion (log ₁₀ ohms)	8·0—9·5
Volume Resistivity (as moulded) (log ₁₀ ohm cm.)	9·5—11·5
Power Factor at 10^6 c/s.	·05—·065
Permitivity at 10^6 c/s.	5·00—5·65

A material relatively easy to mould. In 1"—2" grinding it can be "snowballed" to a bulk factor of 6. It can be supplied in large flake if desired, and in this form is especially suitable for flat mouldings. Available in limited range of colours.

The Immortals always liked to get the better of each other. Thus, when Copreus had a horse called Orion —gifted with speech and capable of unbelievable speed— Neptune improved on the idea and evolved his wonderful winged steed Pegasus, the first airborne equine, the favourite mount of Apollo.

Later, however, Bellerophon—a mortal—stole Pegasus. Then the problem arose of how a celestial steed carrying a mortal could come on the Earth without crash-landing.

Bellerophon besought the aid of Neptune to produce a wonderful shock and impact-resisting compound and which he applied to the hoofs of Pegasus. We append the modern Nestorite equivalent of the formula.

YOU'RE RIGHT WITH 'NESTORITE'

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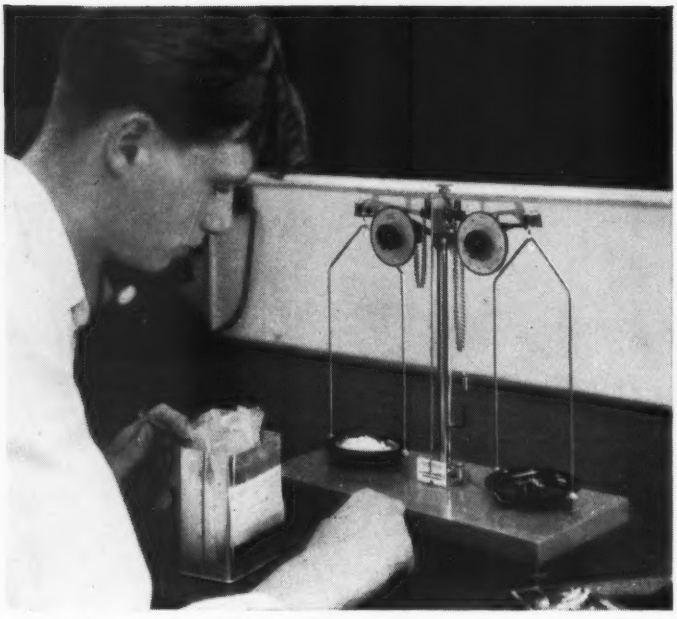

1 *Weighing dye for Colourant Blend mixing.*

2 *Filling drum tumbler with Colourant Blend.*

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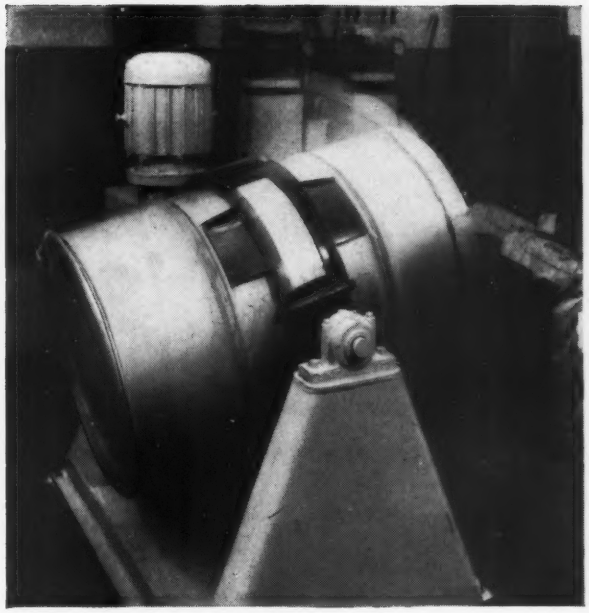
3 *Adding dye to Colourant Blend in drum tumbler.*



4 *Drum tumbler in operation.*

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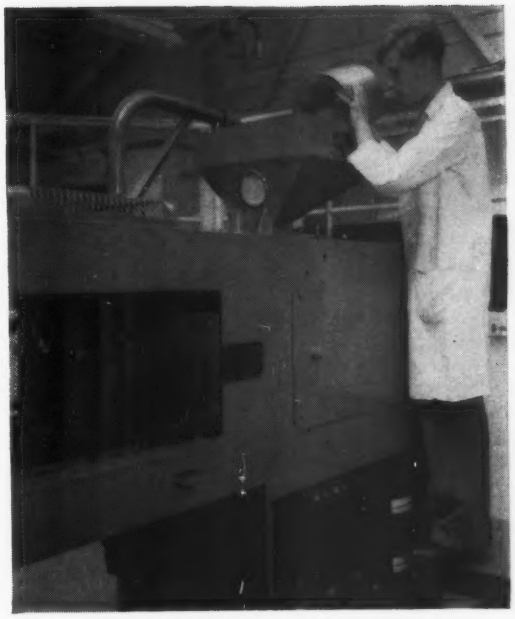

5 *Charging the injection moulding-machine hopper with Colourant Blend.*

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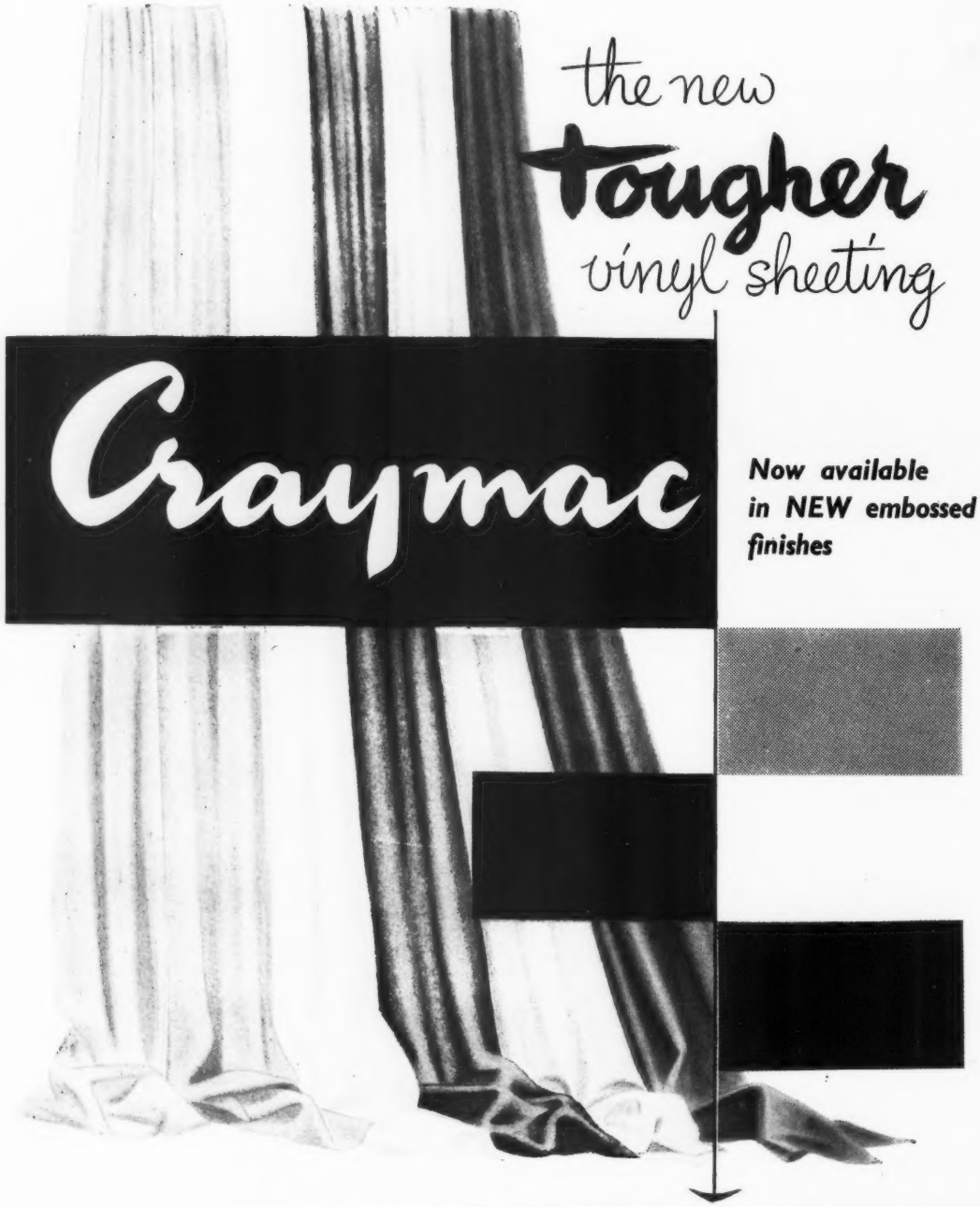

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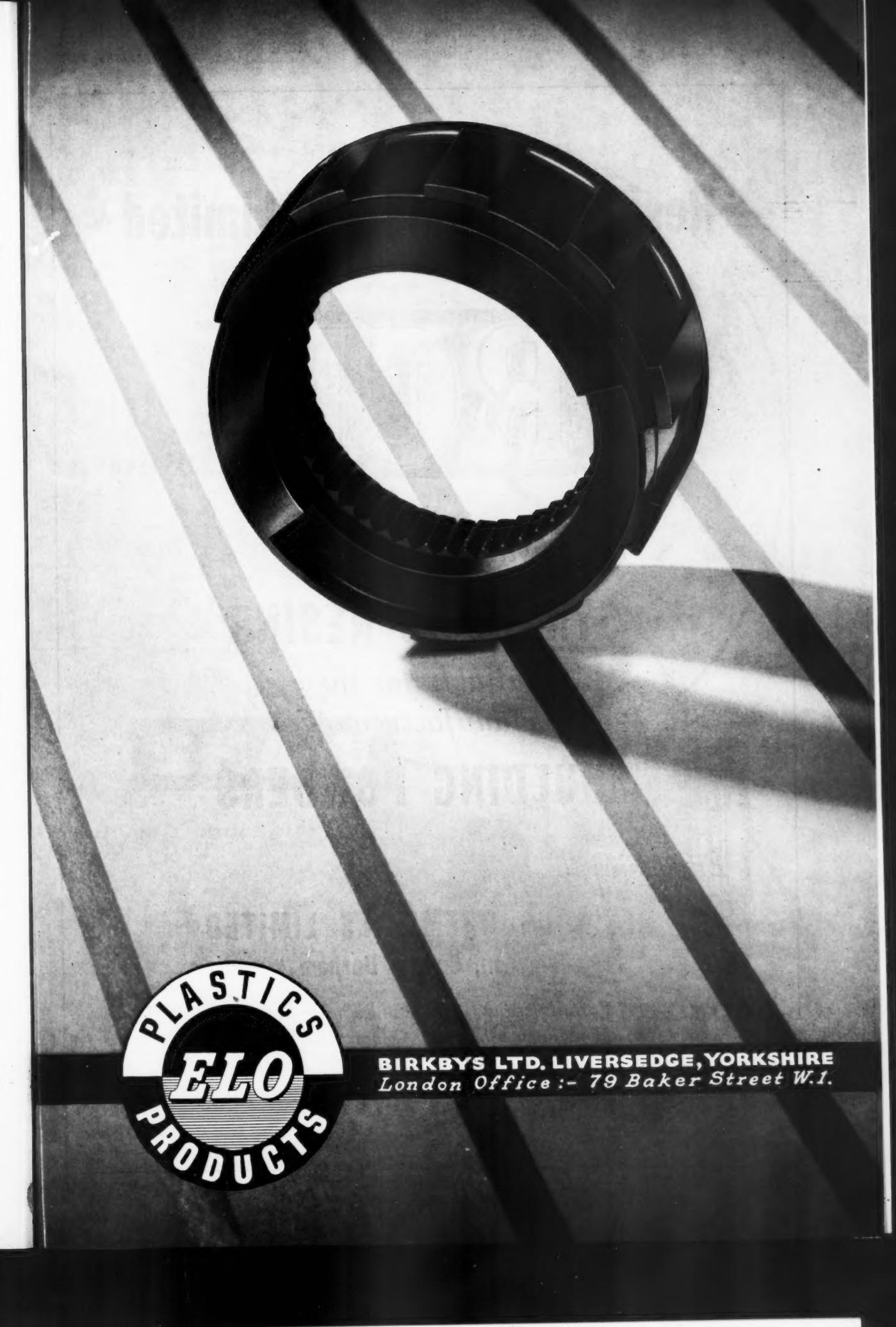
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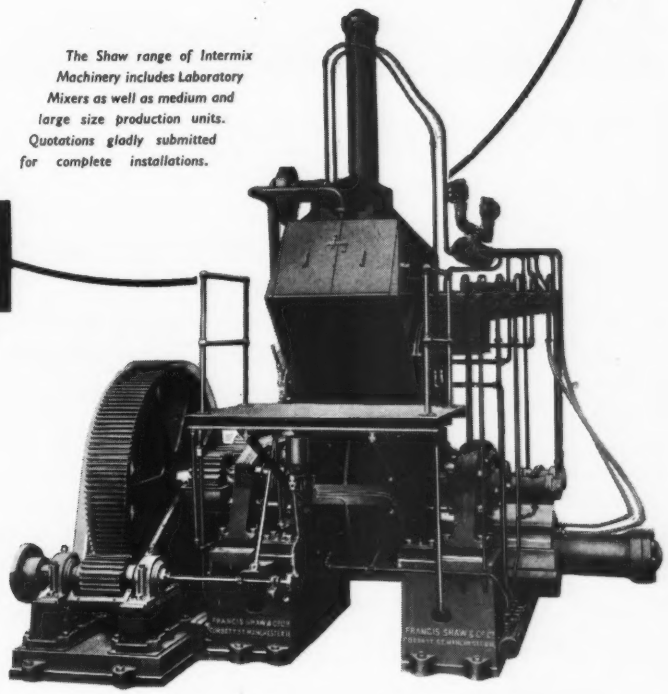

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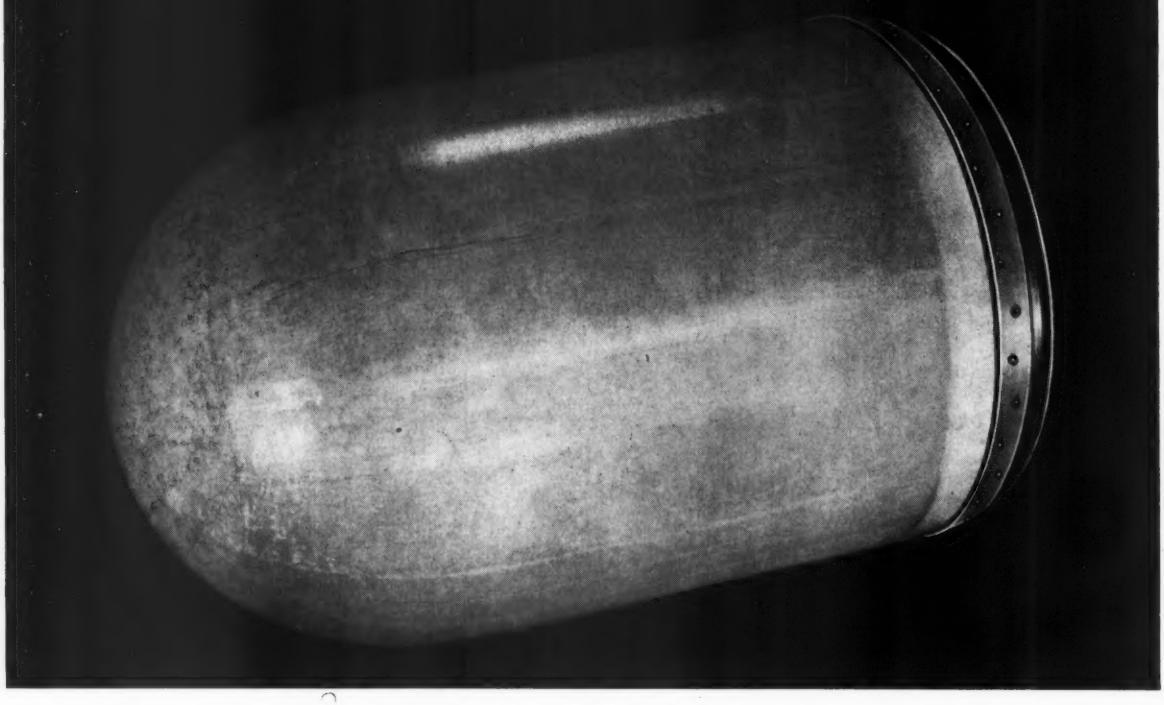

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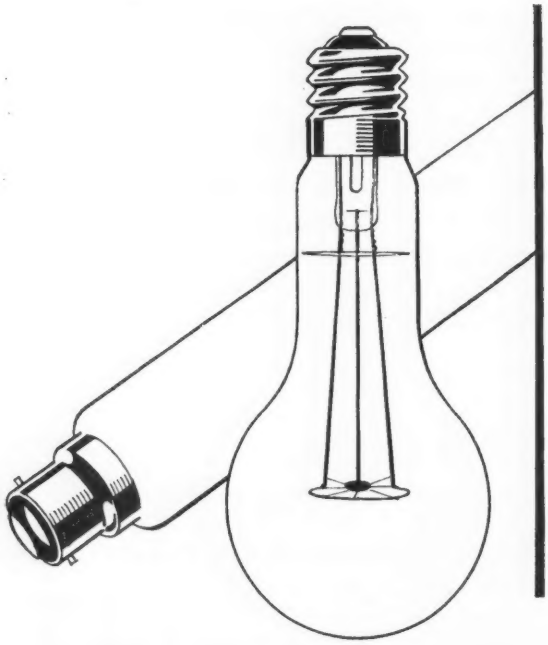

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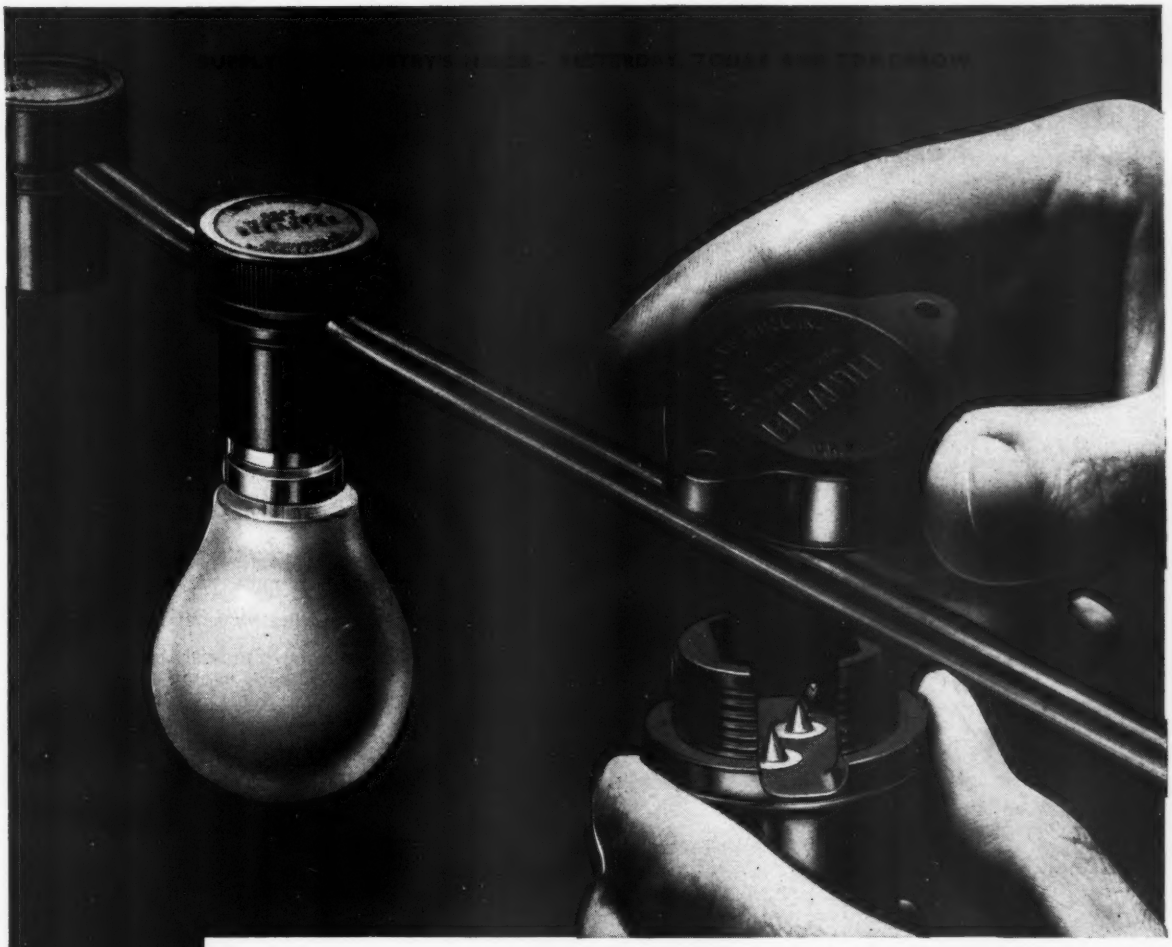

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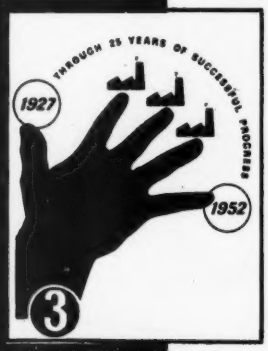

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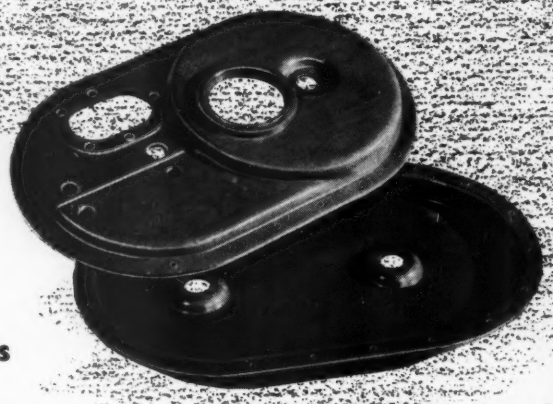

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Plastics

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EDITOR: M. D. CURWEN, B.Sc., A.R.I.C.

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General view of the moulding shop at the St. Helen's, Lancs, factory of Ashdowns, Ltd. In it there are some 80 *presses ranging from* 10 *tons to* 1,500 *tons capacity.*

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Plastics

VOL. XVIII. No. 186 JANUARY, 1953

EDITORIALS

Fluid Transport

WE do not know of any definition which tells us at what stage a pipe becomes a tube or vice versa, or where a cylinder comes in the scheme of such things. The choice of the word appears to be partly industrially traditional since we talk of water pipes and drainage pipes in building, but boiler-tubes in steam-raising, while a chemist will talk of gas-pipes when he means iron pipes conveying towns' gases and of tubes (or the curious "tubing") where he means glass, rubber or other tubes conveying other gases and liquids whether in the laboratory or in the works. The word cylinder is almost specific to the electrical industry and the chemical industry. Yet another word, "duct," is now upon us and is apparently specific to the aircraft industry so far as hot-air tubing is concerned. New ones may yet arise. Not that a clear definition is important, but the use of a multiplicity of words where one should be sufficient may be confusing to those unacquainted with the vagaries of our language.

However this may be, such structures made from plastic materials are becoming of increasing importance to the industrial world and elsewhere. It does not need much technical knowledge to realize that wherever large quantities of liquid or gas are to be moved to, within and from a factory over small or large distances, pipes or tubes must be used. Traditionally they have been made of lead, copper, silver, tin, iron, steel, aluminium and other metals, of earthenware, glass, fused silica, concrete, wood, rubber, ebonite and carbon; in fact, almost any workable rigid or semi-rigid structures, according to availability, cost and purpose. Their use has ranged from the age-old necessity of transporting water to the relatively modern movement of gases, liquids and, on occasion, solids in powder or grain form. The choice of material for the piping of such fluids, which may exist under cold or hot conditions, depends mainly upon the corrosive action of the fluid on the pipe material and upon the action of the pipe material on the fluid. It is obviously important to avoid contamination, discoloration and spoilage of foodstuffs, pharmaceuticals and other "delicate" materials by metals.

With the advent of plastic tubing, even with the few types at present available, industry and non-industrial life possess a new important tool. We believe the earliest and rare use of plastic tubing was that of celluloid in the form of short sight "glasses" in petroleum technology, presumably to avoid breakages. On the other hand, if we include rubber and ebonite in the same field, the former has long been used for the transport of hydrochloric acid and hydrogen peroxide and ebonite for brine in refrigeration plant.

An important advance took place about the middle 1920s with the construction in Germany of chemical plant and rigid chemical piping made from a phenolic resin-asbestos material of great acid resistance and considerable heat resistance. But of far wider importance was the appearance of the p.v.c. tube and, later, of the polythene tube, both originally produced by welding from sheet (polythene tubing was also experimentally produced by centrifugal casting), a process limited in speed of production although very flexible in its ability to produce diverse shapes. Of greatest importance have been the advances made in the continuous extrusion of tubing. This technique had begun before the war using plasticized p.v.c. and to-day has reached formidable dimensions for the production of gas tubing, garden hose, petrol hose, etc., while the new extrusion of unplasticized or hard p.v.c. has resulted in the production of chemically resistant piping for acid transport and fume removal. Present production here is limited, so far as we know, to 3-in.-diameter tubing, but 12-in. hard p.v.c. piping is already being made in Germany.

So far as polythene is concerned, production and use in this country is more advanced, since 8-in. extruded piping for chemical drainage was produced in 1947 and 12-in. piping in 1949. The use of smaller diameter extruded piping for domestic cold-water use is promising and tentative specifications have already been laid down. It is already widely employed for acid conveyance in most chemical works in the country and abroad, and is in process of becoming standard for beer transport in public houses.

These two materials, p.v.c. and polythene, are outstanding for their resistance to corrosion, and therefore for their long life under corrosive influences, or, alternatively, have little or no effect on the liquid conveyed by them. In these properties and ease of installation lies their importance as compared with certain traditional metals.

On the other hand, both polythene and plasticized p.v.c. have their limitations—that of low heat resistance: neither can be used at temperatures near the boiling point of water. Nevertheless, the field before them is great enough. Unplasticized p.v.c., however, can be used up to 150-160 degrees C.

What of the future? Tubes, e.g., hot-air ducts for aircraft, are now being made of glass-fibre or asbestos reinforced resins which withstand considerable heat. Whether or not these will find use as more general piping may be a matter of prime cost, but first cost may matter little in special cases. On the other hand, the exceptional strength may favour the fabrication of very large tubings for special purposes, and perhaps for the tubing that becomes a closed cylinder—we refer to the production of cylindrical tanks for the transport by rail or road of liquids ranging from petrol to inks, from acids to molasses and from alcohol to lubricating oil.

Rubber and Plastics

THERE is something very significant about the advertising campaign launched during the past year or so by the leather producers, who are insisting on the hoardings of the London underground railway system, and no doubt elsewhere, that "There's nothing like Leather." Some years ago we wrote an article under exactly the same title explaining why, because of this very truth and because leather is a natural "living" thing, such insistence may prove a double-edged sword. Like the little girl, when leather is good it is very, very good, but when it is bad it is horrid. Recent examination of some shoes and boots, costly and sold by some of the better shops, shows that, on occasion, leather can be poor: when it is poor and porous it can be unpleasant and unhealthy.

It is no wonder, therefore, that many of the rubber factories of the world are seeking to replace it by new rubbers. During the past many years natural rubber has had its place, albeit a modest one. To-day, however, by the introduction of the

new synthetic polymers, great strides have been made, especially so far as soling is concerned, being completely non-porous, with more than double the life of good leather.

For the past two years the Avon India Rubber Company, through its subsidiary Avon Footwear Sales, Ltd., has been producing Nuberlite, which we believe to be a compounded butadiene-styrene co-polymer. Last month it was announced that the Goodyear Tyre and Rubber Company are putting a similar material, Neolite, on the market. Several examples of shoes made from these and other compounds were on view at the recent Leather Fair, a fact in itself astonishing.

Industrial Marriage?

THE knowledge that most rubber manufacturers are employing synthetic resins in several forms, and the fact that manufacturers of plastics materials are very much interested in modifying their products with natural or synthetic rubber raises the important problem of the relations between the two industries. Both produce raw materials that, to chemists and physicists, are very closely allied and both use some that are identical; furthermore, both employ similar processes and machinery. Yet because of the natural origin of rubber and the fact that its physical properties bore no apparent relation to the few early plastic materials, historically and economically the two industries have grown up almost without contact.

There now exists in London a National College of Rubber Technology, beautifully equipped with scientific apparatus for research and testing, and machines for teaching technology. The College also provides excellent courses in plastics technology. Can we not see in it the germ of a future National College of High Polymer Technology?

MOULDING POWDER AND SHOT

Piping Hot News

The notes on piping on the previous page reminds me that in 1949 I borrowed an 8-ft. length of 8-in. diameter extruded polythene tube from Tenaplas, Ltd., to decorate our stand at the British Industries Fair. It created enormous interest among visitors and I wondered at the time who would be the first to use the piping in actual works practice. We have now received the news that I.C.I., Ltd., after having tested the 8-in. piping, have laid down at their Billingham nylon works the largest drain of plastic material ever used in Great Britain. This, too, is of polythene 12-in. diameter, and has also been extruded for them by Tenaplas, Ltd. Four hundred feet of it have been laid about 6 ft. deep and part of it was a continuous length of 120 ft., which was jointed in the workshop. One end was let down into the trench and its flexibility allowed it to be "threaded" between the timbers shoring up the trench sides. The properties of polythene make the tube particularly suitable for installation in a chemical plant like the nylon works. It is light—a 12 ft. length is easily lifted by an average-size man—and also flexible, so that long lengths can easily be joined together before laying by a process using a jet of heated nitrogen or air. This means that the trench need not be dug until the tube is ready, the laying can be rapidly done—75 ft. were laid in 10 minutes and the trench filled in almost at once. It is unaffected by most concentrated mineral acids and all alkalis. These qualities, and its lightness and great strength, give it a big advantage over earthenware pipe, which is heavy, has to be laid in short sections which must be joined up in the trench and for which, if corrosive liquids are to be drained away, a special jointing component must be used.

* * *

Down in the West Countree

On December 12 I travelled to Cheltenham to join in the celebrations at the annual dinner of the virile Western Section of the Plastics Institute and to taste once again traditional Gloucestershire hospitality. Met up with a host of old friends, for among the crowd were Mr. T. E. Birrell, President of the Plastics Institute; Mr. C. R. Todd, Chairman of Council; Mr. Chaumeton, Vice-President; Mr. T. Halse, Chairman of the Western Section; Mr. D. W. H. Fletcher, Chairman of the Midlands Section; Mr. John Harvey, Mr. J. H. Collins and our own Uncle Bob Hartley and all. And, of course, my mentor in technical laminates, to whom I shall be ever grateful, Mr. A. A. Heath, founder Chairman of the Western Section, whose truly model works now dot the countryside and who strides half-way across the world buying up beech forests to feed them. Mr. T. E. Birrell replied to the toast "The Plastics Institute" in his best serio-humorous manner and also delivered what sounded like a running commentary on "The Bible and Pharmacy." Mr. T. Halse proposed the toast of "Our Guests" and Mr. C. R. Todd replied. All the important people received presentations: Mr. T. Halse a plastic "chain of office" and I a beautifully unbound first edition of the Gloucester "Citizen" for December 6, presumably to show me how a high-class scientific and technical journal is run. It gave me the good news in "banner headlines" that "Stroud Defence stood firm in the Blizzard." At-a-boy!

* * *

Industrial Philosophy

Anything that replaces metal efficiently pleases me greatly, not that I am "anti-metal" at any price, but because I am fearful of the world's metal supplies, for the world is clearly a destroyer of metal resources. On the other hand, the plastics industry is a creator of resources which, to all intents and purposes, are unlimited. I often wish there existed a Chair of Industrial Philosophy in some university to guide our industrialists and political leaders. Some of the metal replacements I see are small and may often be passed by as unimportant to the casual eye. The plastic saddles or clips for supporting cables or piping I saw recently being used at Vauxhall Motors, Ltd., in Luton, are very small, simple things, but to me are very significant. Probably made of "acetate," they are extremely tough and very strong, can be cut for difficult corners, and the workers putting them up are intelligent enough to soften them with a "lick" of a blow-lamp when they want to bend them. They are very adequate for the job and, of course, they will never result in rust stains on nice walls in factories.

DOGSBODDY.

Production of Glass Fibre Preforms at Ashdowns, Ltd.

The following notes describe the work of Ashdowns, Ltd., of St. Helens, Lancashire in the field of reinforced glass fibres with special regard to the recent installation of a Turner Atherton machine. The machine may be regarded as the first automatic process in the country for the batch production of preforms of "Fibreglass" mats which are converted into finished mouldings in low-pressure compression moulding machines.

PROGRESS in the research and production of glass fibre reinforced synthetic resins (especially polyesters) in this country, probably reaches its highest and most comprehensive form to date in the works of Ashdowns, Ltd., a fact related directly to the company's long and close association with the glass industry. The history of the company goes back to the formation, about 1919, of H. E. Ashdown (Birmingham), Ltd., a concern primarily engaged in compression moulding, and its purchase by Pilkington Brothers, Ltd., about the year 1936. The plant was transferred to St. Helens, and to-day Ashdowns, Ltd., is one of the largest moulding concerns in the country so far as capacity is concerned, and one of the most flexible in character since its activities include compression moulding (the shops contain about 80 machines varying from 10 to 1,500 tons and include transfer and plunger types), injection moulding, extrusion, "phenolic"-laminate manufacture and fabrication of finished goods from thermoplastic sheet.

The company was among the first to experiment with the polyester resins, early interest being devoted to their use for bonding "Fibreglass" cloth. Present work in this field also now includes the bonding of the cloth with phenolic, urea, melamine and silicone resins, the latter being of special interest to the electrical industry.

As was discussed in our notes on the Fibreglass Convention last year, reinforcement of synthetic resins with glass fibres may be carried out, depending on the requirements of the finished structures, by using one of three types: yarn, mat or cloth.

Yarn consists of bundles of filaments of glass which are of "infinite" length held together by an organic chemical binder in parallel bundles, i.e., the filaments are not twisted together as in textile yarns; this is the cheapest form of "Fibreglass." Rovings are made by running together a number of yarns in a parallel fashion, using a binding emulsion to produce a single cord which is a multiple of the number of yarns used; usually 60 yarns are used for this purpose.

Mat consists of the above yarn chopped into short equal lengths of 2 to 3 ins., deposited in random fashion on an endless moving belt, so as to form a "carpet," and held together by means of a chemical binder.

Cloth is, as the name implies, a woven tissue of yarns produced in very much the same way as normal textile cloth.

It will be obvious that yarn is the cheapest form of "Fibreglass," since it is made by fewer processes than the other three, but for practical reasons rovings have to be used for preforms. If, therefore, we can arrange these rovings to conform to the shape required to form the "skeleton" for the moulding to be produced, we shall have a strong, reinforced moulding able to withstand impact shocks, produced by the most economical process at present available.

This "skeleton" is known as a "preform," and it is the production of this "preform," and its subsequent transformation into a moulding, which is the subject of the following descriptive notes.

The Turner Atherton machine, which produces the "preforms," is the first to be made and used in this country, but the principle on which it works is only a modification of a process which has been in use for nearly one hundred years in the felt hat industry, using rabbit fur instead of chopped roving as its material. The machine consists basically of a closed chamber below which is a powerful suction fan which draws air through a duct at the top of the chamber down through a screen placed at the bottom. The screen, which is made of perforated metal, is in the form of the "skeleton" or "preform" to be produced, or in some instances where the preforms are small in size, the screen carries several such forms. Glass roving is automatically fed into a cutter, which

The Turner Atherton automatic machine for making moulding preforms from "Fibreglass" is the first to be produced and used in this country. The hopper in the centre of the machine feeds glass roving to the cutter below.

Three stages in the production of a glass fibre reinforced moulding: (left) preforms having been formed by suction on the Turner Atherton machine are sprayed with a resin binder and dried before they are transferred to the moulding press; (centre) the preform is placed in the female tool and liquid resin is poured over it; (right) the finished moulding is removed from the press.

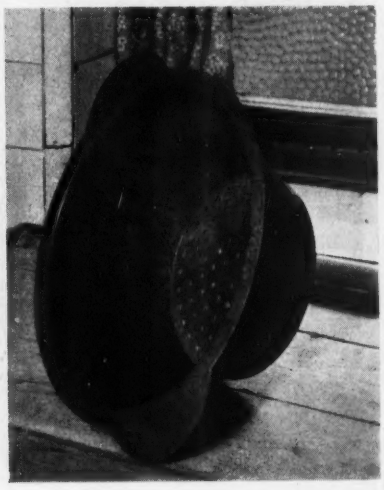
chops the material into suitable short lengths (generally 2 ins. long) and feeds these short strands into the air duct entering the chamber near the top. The flow of air through the screens then sucks the strands through the chamber, giving a snowstorm effect, and draws them tightly and evenly, although at random orientation, on to the screens in the desired shape. This process continues for a predetermined time in order that the required weight of fibres can be deposited on each preform; the cycle is electrically controlled and is accurate within 5 per cent. During the deposition of fibres, the screen is rotated within the chamber in order to ensure a completely uniform thickness of deposition of the glass fibres.

On completion of the cycle, the fan is cut off and the chamber doors opened, giving access to the screens, when it can be seen that the preform now exists; in its present condition, however, it could not be handled without disintegrating, and to overcome this difficulty the preforms are sprayed with a binding emulsion and then baked for a short time in a special oven through which hot air is rapidly circulated. This treatment dries the binder which bonds together the individual fibres where they touch each other, and as a result the preforms, when cool, can be lifted from the screens and are then in a condition to be handled for the subsequent moulding operation.

Moulding is carried out in a hydraulic press using an accurately made positive-type steam-heated mould which consists of a male and a female portion fitting together in such a way when the press is closed that a predetermined residual volume of the same shape as the finished moulding is entrapped between the two halves. Into the open mould is placed the "preform" and on to it is poured a measured amount of polyester resin which contains a proportion of inorganic filler and colouring pigment; the mould is then closed and pressure applied to a predetermined amount not exceeding 250 lb./sq. in. Due to the pressure applied, the liquid resin flows through the preform filling the voids between the individual fibres and coating the fibres; and as the resin and preform together completely fill the residual volume of the closed mould, a smooth surface is produced. The steam-heated mould causes the resin to set or "cure" after some minutes, varying from 3 to 7 minutes according to size and to type of resin used, and on completion of the interval, the hydraulic press is opened and the finished moulding extracted.

Inspection of the finished moulding will show that the surface is not quite as smooth and glossy as that normally associated with some plastic mouldings, and this is due to the reduced moulding pressure of up to 250 lb. per sq. in., and also to the fact that glass fibres are non-absorbent and cannot be impregnated with resin. Higher moulding pressures are not desirable, since they tend to cause a "washing" or flow of the glass fibres, which then tend to collect on corners, giving a patchy distribution throughout the moulding which is undesirable. In addition, high pressures would tend to crush the individual glass fibres, laid as they are across each other throughout the preform, and glass fibres, although immensely strong in tension and flexion, are less able to withstand shearing and crushing forces.

The main virtue of the finished moulding is its mechanical strength and lightness, and the fact that this quality can be combined with an intricate shape and the whole article produced by mechanical means which lends itself to quantity production and close control throughout the process. In



The finished moulding—a kitchen colander reinforced by means of a glass fibre preform.

addition, the material will withstand blows without deformation, which is an inherent defect in metal pressings and stampings with their tendency to " dent " as the result of a blow or mishandling. Moreover, should a glass laminate suffer a sufficiently heavy blow as to cause a delamination, which is shown as starring or crazing effect, or even if a small puncture is caused, the application of a small amount of resin to the point of injury will effect a repair which is almost as good as new, and this repair can be carried out as quickly as putting a patch on a tyre.

These mouldings have an enormous field of application such as housings for machine units and calculating machines; containers and boxes of all kinds; trays for household use for bread, fish, etc.; firemen's helmets; miners' and motorcyclists' protective helmets; protective boot toe caps; washing machine tub and cover; parts for refrigerators; housing for radar, radio and electrical equipment; fins; aerofoil section and ducts for aircraft, etc.

Production from mat, tape and yarn

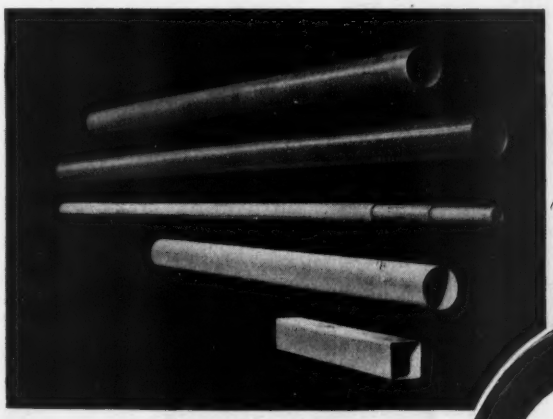
In addition to automatic production on the Turner machine, Ashdowns, Ltd., have carried out for some years the production of rods, tubes and other structures by the well-known processes of winding, laying and forming.

Tubes are fabricated by the glass tape method. Here a mandrel is rotated between lathe centres and glass tape is wound on, and subsequently impregnated with polyester resin in suitable proportion; usually several layers of tape are used to produce the required wall thickness. When the required dimensions have been obtained, Cellophone tape is wound on by the same method prior to curing, thus giving a smooth exterior surface. The Cellophane is, of course, removed after curing. Tubes are also made from glass yarn. With this type of tube, several yarn ends from bobbins are automatically fed on to a rotating mandrel in such a way as to produce the correct helix angle of yarn on the tube for maximum strength. Resin is applied to the layers of yarn at regular intervals in the correct proportion, and when the required wall thickness has been obtained the tube is wound with Cellophane tape, as before.

Rods are manufactured from parallel glass fibres in the form of yarn. The strands of yarn are wetted with a polyester resin and the saturated fibres pulled into a tube which acts as a mould. The assembly is then cured, either at room temperature or by heat in an oven.

Irregular structures include a sewage gate, " dodg'em " car, motorcar wing, aircraft fin tip. These articles are made by lay-up technique using tailored " Fibreglass " mat, placed by hand on or into a former and impregnated with a self-curing polyester resin. Depending upon the finish required, the surface of the moulding can be sanded and spray painted if so desired.

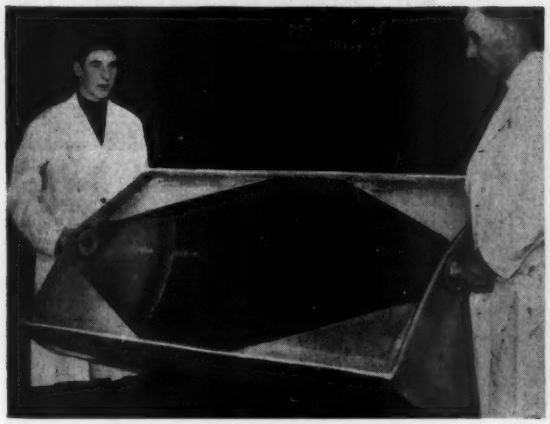
The translucent corrugated sheet Undulite is manufactured from glass fibre mat which is impregnated with a suitable polyester resin and sandwiched between two layers of Cellophane, care being taken to exclude air bubbles. The resulting sandwich is then pressed under light pressure between formers having the desired profile and cured to room temperature. Undulite is supplied in various profiles to match the standard asbestos and galvanized iron sheeting and in a range of colours.



(Above) Rods manufactured from yarn.

(Right) Undulite sheet.

(Below) Car wing made by lay-up technique.

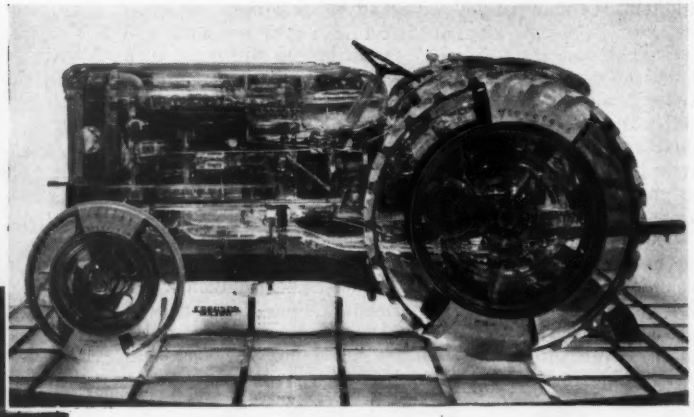


(Left) Sewage gate.

(Right) Bonnet of " dodg'em " car.

TRANSPARENT CASTINGS

FOR FORD TRACTOR DISPLAY

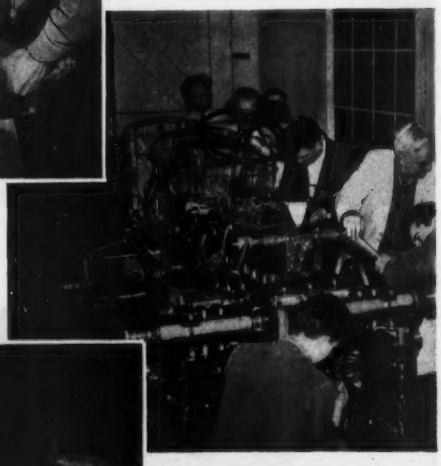


Cut-away sections, semi-transparent parts, mirror finishings, etc., are by no means new devices in the display world. As the photographs show, the technique employed by Ford to produce the exact transparent replica of the new Fordson Major Tractor is entirely new and opens up exciting possibilities. Transparency in the cast phenolic resin components was maintained by the use of pure raw materials and corrosion-free equipment.

(Above) Special casting techniques were evolved for each component. Curing was carried out at 80° C. for 4 to 6 days.

(Left) Work in progress on the hydraulic lift housing. Actual parts were used as patterns; these were frequently plated or painted to reduce finishing costs.

(Right) Assembly being carried out in the Ford Trade School.



(Above) Machining a transparent rear axle housing. For intricate castings, sectional and withdrawal cores were designed by the Ford Pattern Shop. Finishing methods were similar to standard practice.

(Left) One of the front wheel castings being turned. Only metal parts used were pistons, connecting shafts, gears and axle shafts.

Photographs by courtesy of the Ford Motor Company, Ltd.

Cellulose Acetate Butyrate—II

A Comparison with Cellulose Acetate

By E. E. HALLS

Having compared cellulose acetate and cellulose acetate butyrate with regard to their properties in moulded components, the author goes on this month to compare these materials in the form of sheets and tubes.

2. Sheet.

Cellulose acetate butyrate sheet is produced in a full colour range, similar to that for cellulose acetate sheet, opaque and transparent, self-coloured as well as variegated and tortoiseshell effects. The usual range of thicknesses is provided, from 1/32-in. to ½-in. being normal, with thinner and thicker gauges possible if required. It is one of the most easily machined of the thermoplastics, responding to sawing, milling, drilling, tapping, and counter-sinking and engraving quite readily. The material in the lower thicknesses can be formed or pressed to shape, with judicious and controlled heating. Joining by means of solvent or cellulose adhesives and cements is satisfactory.

Sheet material can be printed, or it can be attractively marked by engraving and filling with coloured oil-bound engraver's filler or wax pencil. Again, it may be directly marked by the hot foil method to give permanent coloured patterns. On labels, instruction plates and display cards, these markings may be applied in reverse on the rear face of the sheet and then covered by a sprayed coating of cellulose enamel in contrasting colour, so that the pattern is undisturbed by dusting, scratching etc.

Table 1 shows some general properties of cellulose acetate butyrate sheets compared with those for cellulose acetate. The white acetate sheet, sample 3, is pigmented with mineral filler, otherwise the materials are coloured with dyestuff, and are unloaded. The water absorption values for the acetate butyrates are very appreciably lower than those for the acetates, as also are the losses on heating. Again, plasticizer content is, broadly speaking, about half that for the acetate materials. The electrical resistance is noteworthy, insulation of the acetates being measurably affected by the water immersion period, whereas that for the acetate butyrates is unaffected. The test employed was the British Standard three-stud method, using square test pieces, three metal inserts equilaterally positioned at 1½-in. centres; the term "infinity" signifies a minimum of 150,000 megohms.

These data show that acetate butyrate sheet is superior to acetate sheet, showing better resistance to mild heat or dry conditions, and superiority under damp or wet conditions. It is also an improved cellulose thermoplastic from the electrical point of view. The greater stability of the material is shown by more detailed examination over extended periods of dry heat, water submersion and humid atmospheres.

Table 2 reveals performance under extended water immersion, assessment being from measurements of weight, length, width and thickness at intervals up to a total time of 400 days. Specimens were 1½ in. sq. with smoothed edges. The data not only show that the changes induced in the acetate sheet are much larger than those caused in the acetate butyrate sheet, but that the progress of the changes is somewhat different in the two materials. Thus in the case of acetate,

Table 1.—General Characteristics of Cellulose Acetate Butyrate Sheet

Material	Cellulose Acetate			Cellulose Acetate Butyrate		
Sample No.	1	2	3	4	5	6
Colour	Black	Clear Colourless	White	White	Tortoise shell	Red
Thickness, inches	0.0387	0.160	0.078	0.165	0.185	0.500
Total ash on incineration (per cent.)	Traces	0.01	16.0	0.93	0.25	0.76
Gain in weight on water absorption (24 hrs. at 25°C., per cent.)	3.0	1.5	2.5	1.2	1.0	0.5
Loss in weight on dry heat at 60°C. (24 hrs., per cent.)	1.7	1.3	1.3	0.6	0.7	0.4
Insulation resistance as received (megohms)	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
Insulation resistance after 24 hrs. in water at 25°C. (megohms)	56,000	20,000	2,500	Infinity	Infinity	Infinity
Plasticiser content (per cent.)	21.0	26.7	21.5	12.3	11.2	8.0

Table 2.—Behaviour of Cellulose Acetate and Acetate Butyrate Sheet under Conditions of Continuous Water Immersion at 25°C. Changes in weight and Dimensions.

Sample No.	Material	Colour	Test Period in days	Parts per Thousand Change in			
				Length	Width	Thickness	Weight
1	Cellulose Acetate	Black	1	+ 4	—	−14	+30
			30	− 6	—	−20	− 2.5
			200	−28	—	−40	−60
			400	−41	—	−38	−70
2	Cellulose Acetate	Clear Colourless	1	+ 2.7	+ 2.7	+ 0.7	+15
			30	+10.0	+ 8.0	+12.0	+40
			200	+ 2.7	+ 0.7	+10.0	+16
			400	− 0.6	− 3.5	+ 4.5	+10
3	Cellulose Acetate	White	1	+ 6.7	+ 6.0	+ 5.0	+25
			30	+ 8.0	+ 6.0	+11.5	+27
			200	− 1.3	− 2.0	+ 9.0	+ 4
			400	− 6.5	− 7.5	—	− 0.5
4	Cellulose Acetate Butyrate	White	1	+ 2.0	+ 2.0	− 2.0	+12
			30	+ 6.7	+ 7.0	+ 4.0	+25
			200	+ 5.0	+ 5.3	+ 2.7	+28
			400	+ 6.0	+ 4.7	+ 4.0	+26
5	Cellulose Acetate Butyrate	Tortoise shell	1	+ 2.0	+ 2.0	− 2.0	+10.0
			30	+ 5.5	+ 4.0	+ 2.5	+24.0
			200	+ 5.3	+ 4.7	+ 4.5	+25.0
			400	+ 4.7	+ 4.0	+ 0.5	+24.0
6	Cellulose Acetate Butyrate	Red	1	+ 1.3	+ 2.0	+ 1.0	+ 5.0
			30	+ 4.0	+ 2.0	+ 5.5	+18.5
			200	+ 5.3	+ 2.0	+10.0	+26.0
			400	+ 5.3	+ 3.3	+ 8.8	+24.5

Table 3.—Behaviour of Cellulose Acetate and Acetate Butyrate Sheet under Conditions of Dry Heat at 60°C. Changes in Weight and Dimensions.

Sample No.	Material	Colour	Test Period in days	Parts per Thousand Change in			
				Length	Width	Thickness	Weight
1	Cellulose Acetate	Black	1	−21	—	− 3	− 17
			30	−34	—	− 6	− 54
			200	−48	—	−66	− 95
			400	−58	—	−66	−120
2	Cellulose Acetate	Clear Colourless	1	− 5	− 4	− 4	− 13
			30	−10	− 9	−12	−25
			200	−16	−16	−18	− 44
			400	−24	−21	−22	− 56
3	Cellulose Acetate	White	1	− 4	− 3	− 4	− 13
			30	−10	−10	− 8	− 25
			200	−16	−18	−22	− 45
			400	−24	−12	−26	− 62
4	Cellulose Acetate Butyrate	White	1	− 0.6	− 1.5	− 4.0	− 6
			30	− 0.6	− 3.3	− 4.0	− 7
			200	− 4.5	− 5.5	− 6.0	− 12
			400	− 8.0	−10.0	−10.0	− 23
5	Cellulose Acetate Butyrate	Tortoise shell	1	− 1.5	− 0.5	− 3.0	− 6.5
			30	− 3.5	− 2.0	− 6.5	− 8
			200	− 5.0	− 3.0	− 7.0	− 12
			400	− 8.0	− 5.0	− 6.0	− 18
6	Cellulose Acetate Butyrate	Red	1	Nil	+ 2.0	+ 0.4	− 4.5
			30	− 1.4	+ 0.7	+ 0.6	− 6.5
			200	− 2.0	Nil	+ 2.0	− 6.5
			400	− 3.0	− 0.5	+ 1.6	− 8.5

an initial expansion or increase in weight is in general quickly followed by a marked shrinkage and loss which progressively becomes greater. The acetate butyrate, however, shows a smaller expansion and gain in weight, which gradually becomes a little larger, finally falling off again without becoming negative. The difference in behaviour is largely accounted for by the difference in plasticizer content, and the greater expulsion of plasticizer from the acetate in the water immersion process.

Table 3 shows the results of extended exposure to dry heat at 60 degrees C., the general trend being towards shrinkage and loss in weight. The initial and final changes are very much greater for acetate sheet than they are for acetate butyrate sheet. The test establishes the marked superiority of cellulose acetate butyrate for service conditions involving moderate heat.

Table 4 summarizes data provided by the fluctuating warm and cool, dry and wet tests. Considerable distortion was recorded with the acetate sheet, and again, the changes with these materials were very much greater than with the acetate butyrate specimens.

With regard to the comparatively severe cyclic hot dry and hot wet tests (Table 5), the acetate butyrate samples passed through these very well indeed, whereas distortion was recorded with the acetate sheets, and the movement and weight changes were very much greater.

Summarizing, cellulose acetate butyrate sheet satisfactorily withstands the severe hot and wet conditions whereas acetate fails; it behaves very much better under both water immersion and dry heat conditions, and where a combination of high humidity and moderate heat is imposed. The material is suitable for display cards and simple containers, and for labels, dials and panels of instruments and apparatus, for insulating strips and small blanked components for electrical apparatus.

Table 4.—Behaviour of Cellulose Acetate and Acetate Butyrate Sheet under Conditions of Mild Humidity. Changes in Weight and Dimensions.

Sample No.	Material	Colour	Test Period in days	Parts per Thousand Change in			
				Length	Width	Thickness	Weight
1	Cellulose Acetate ..	Black	1	+ 3.5	—	−13	+ 20
			30	−10.0	—	−35	− 7.5
			200	−24.0	—	−25	− 34
			300	Distorted	—	Distorted	− 85
2	Cellulose Acetate ..	Clear Colourless	1	+ 0.7	+ 1.5	− 0.6	+ 6.5
			30	− 0.7	+ 1.5	+12.0	+14.0
			200	−10.0	− 8.5	+14.5	+ 0.5
			400	−36.0	−38.0	+130	−10.5
3	Cellulose Acetate ..	White	1	+ 3.5	+ 3.0	+ 1.3	+ 12
			30	− 0.6	− 0.7	+ 8.0	+ 10
			200	− 7.5	− 8.0	+ 9.5	+ 0.5
			300	Distorted	Distorted	Distorted	+ 2.7
			400	Distorted	Distorted	Distorted	+ 4.5
4	Cellulose Acetate Butyrate	White	1	+ 0.6	Nil	− 1.2	+ 6.5
			30	+ 2.0	+ 1.5	+ 1.2	+11.0
			200	+ 1.5	Nil	− 2.7	+11.0
			400	− 5.5	− 5.5	− 2.7	−14.5
5	Cellulose Acetate Butyrate	Tortoise shell	1	− 2.0	+ 0.7	− 1.0	+ 5.5
			30	− 1.5	+ 3.5	+ 2.2	+11.0
			200	− 2.7	+ 0.7	+ 2.7	+11.0
			400	− 3.5	− 3.0	+ 4.4	Nil
6	Cellulose Acetate Butyrate	Red	1	+ 0.6	Nil	− 0.6	+ 5.0
			30	+ 3.3	+ 2.7	+ 2.5	+20.0
			200	+ 2.7	+ 3.3	+ 5.0	+14.0
			300	Nil	Nil	+ 5.5	+ 4.0
			400	+ 0.6	− 0.7	+ 5.0	Nil

Table 5.—Behaviour of Cellulose Acetate and Acetate Butyrate Sheets under Cyclic Hot Dry and Wet Tests. Changes in Weight and Dimensions.

Sample No.	Material	Conditions	Parts per Thousand Change in			
			Length	Width	Thickness	Weight
1	Black CA ..	(a) Dry heat at 70°C	− 6.5	—	+ 5.2	−22.0
		(b) Wet heat at 55°C	− 6.0			
			Distorted	Distorted	+42.5	+30.0
		(c) Wet heat at 55°C	−20.0			
			Distorted	Distorted	+80.0	+15.0
2	Clear Colourless CA	(a) Dry heat at 70°C	−6.0	− 6.0	− 0.6	−15.0
		(b) Wet heat at 55°C	+ 5.3			
			Distorted	+ 4.7	+16.0	+25.0
		(c) Wet heat at 55°C	+16.3	+ 3.3	+32.0	+34.0
3	White CA ..	(a) Dry heat at 70°C	− 4.0	− 6.0	− 2.0	−18.0
		(b) Wet heat at 55°C	+ 8.7	− 2.0	+28.0	+52.0
		(c) Wet heat at 55°C	− 5.0	−20.0	+40.5	+44.5
4	White CAB	(a) Dry heat at 70°C	− 4.0	− 3.3	− 1.6	− 7.5
		(b) Wet heat at 55°C	+ 1.7	+ 2.7	+ 3.8	+15.0
		(c) Wet heat at 55°C	+ 3.3	+ 6.0	+ 8.0	+18.0
5	Tortoise shell CAB	(a) Dry heat at 70°C	− 3.3	− 1.3	− 5.0	− 7.5
		(b) Wet heat at 55°C	+ 3.3	Nil	+ 5.0	+14.5
		(c) Wet heat at 55°C	+ 4.7	+ 2.7	+ 5.7	+18.0
6	Red CAB ..	(a) Dry heat at 70°C	− 2.0	− 1.3	+ 2.0	− 5.0
		(b) Wet heat at 55°C	Nil	+ 2.0	+ 3.0	+ 6.5
		(c) Wet heat at 55°C	+ 0.7	+ 2.7	+ 6.2	+10.3

3. Tubing.

Tubing and extruded shapes can be readily produced in a wide colour range. They may be used for pipings and for electrical insulation; extrusions are useful for structures and frameworks. In all these applications cellulose acetate butyrate exhibits appreciably better dimensional stability than cellulose acetate materials, and test data similar to that presented for mouldings and sheets are briefly discussed below.

Table 6 gives the general properties for the tubings for a small range of diameters. The materials tested are all unloaded and the low ash values confirm this. Throughout, the plasticizer contents are lower than with the sheet materials.

Table 6.—General characteristics of Cellulose Acetate and Acetate Butyrate Tubings.

Material	Cellulose Acetate Butyrate				Rigid Cellulose Acetate		
Sample No.	1	2	3	4	5	6	7
Colour	White	Red	Blue	Colourless Transparent	Black	Red	Blue
External Diameter, inches	0.255	0.572	0.278	0.115	0.250	0.375	0.218
Total Ash on Incineration, Per Cent. ..	0.42	0.43	0.17	Traces	0.42	0.47	0.31
Gain in Weight on Water Immersion at 25°C, 24 hrs., Per Cent.	1.70	1.52	1.22	2.05	0.55	0.40	0.50
Loss in Weight on Dry Heat at 60°C, 24 hrs., Per Cent.	0.75	0.70	0.69	0.76	2.63	4.00	2.80
Insulation Resistance as rec'd., megohms. ..	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
Insulation Resistance after 24 hours in Water at 25°C, megohms ..	,,	,,	,,	,,	5,000	20,000	35,000
Plasticizer Content, Per Cent.	3.6	9.8	5.3	6.4	13.8	12.5	8.0

The water absorption values for the acetate butyrates are not excessive but are higher than for the acetates, and this must be due to loss of plasticizer by the latter during the immersion. The losses in weight on heating are, however, very much lower than for the acetates. As with the other forms, the acetates show a measurable drop in insulation resistance upon water immersion, whereas the acetate butyrates reveal no such deterioration.

Table 7 deals with changes under water immersion conditions. The acetate butyrates exhibit expansions and weight increases which rapidly reach a reasonably constant value,

and one that is not unduly high. The acetates on the other hand show initial gain followed by a larger and progressive decrease. The superiority of the acetate butyrates is clearly manifested.

Table 8 gives the changes under dry heat exposure at 60 degrees C. All changes are negative, i.e. contraction in volume and loss in weight. They are small for acetate butyrate, and very large for acetate tubings. Table 9 similarly shows performance under the fluctuating mild humidity test. The data indicate that the acetate butyrate tubings undergo small changes over the long time period, whereas the few results available for acetate tubings establish a very large dimensional movement.

Table 7.—Behaviour of Cellulose Acetate and Acetate Butyrate Tubing under Water Immersion Conditions at 25°C. Changes in Weight and Dimensions.

Sample No.	Material	Colour	Test Period in days	Parts per Thousand Change in			
				Length 1	Length 2 or Dia. 1	Dia. 2	Weight
1	Cellulose Acetate Butyrate	White	1	+ 2.7	+ 5.6	—	+17.0
			30	+ 2.0	+ 7.2	—	+26.3
			200	+ 5.3	+11.5	—	+33.5
			400	+ 4.7	+ 8.0	—	+33.5
2	Cellulose Acetate Butyrate	Red	1	+ 2.7	+ 2.7	Nil	+15.2
			30	+ 5.0	+ 4.0	+ 4.5	+22.1
			200	+ 5.0	+ 4.0	+ 4.5	+27.4
			400	+ 5.0	+ 4.0	+ 4.0	+29.5
3	Cellulose Acetate Butyrate	Blue	1	+ 4.7	+ 3.2	—	+12.2
			30	+ 4.7	+ 6.5	—	+21.0
			200	+ 5.3	+ 4.6	—	+25.2
			400	+ 4.7	+ 7.0	—	+25.4
4	Cellulose Acetate Butyrate	Transparent Colourless	1	+ 5.0	+15.0	—	+20.5
			30	+ 5.0	+12.7	—	+26.4
			200	+ 5.0	+15.4	—	+36.2
			400	+ 5.0	+19.0	—	+36.5
5	Cellulose Acetate ..	—	1	+ 3.0	—	—	+ 5.5
			7	−10.0	—	—	−40.8
			30	−25.0	—	—	−76.5
6	Cellulose Acetate ..	—	1	+ 5.0	—	—	+ 4.0
			7	− 8.0	—	—	−38.0
			30	−20.0	—	—	−65.0
7	Cellulose Acetate ..	—	1	+ 3.0	—	—	+ 5.0
			7	−10.0	—	—	−42.0
			30	−20.0	—	—	−67.0

Table 8.—Behaviour of Cellulose Acetate and Acetate Butyrate Tubing under Dry Heat Conditions at 60°C. Changes in Weight and Dimensions.

Sample No.	Material	Colour	Test Period in days	Parts per Thousand Changes in			
				Length 1	Length 2 or Dia. 1	Dia. 2	Weight
1	Cellulose Acetate Butyrate	White	1	− 7.0	−10.8	—	− 7.5
			30	− 8.7	−12.0	—	− 6.5
			200	− 9.3	−13.5	—	− 6.0
			400	−10.0	−12.0	—	− 15.0
2	Cellulose Acetate Butyrate	Red	1	− 1.3	− 1.3	− 1.0	− 7.0
			30	− 2.0	− 2.0	− 1.6	− 7.2
			200	− 2.7	− 1.3	− 4.2	− 8.6
			400	− 2.0	− 4.0	− 4.0	− 16.5
3	Cellulose Acetate Butyrate	Blue	1	− 0.7	− 2.2	—	− 6.9
			30	− 1.3	− 2.2	—	− 7.4
			200	− 3.0	− 1.2	—	− 9.0
			400	− 4.0	− 1.2	—	− 12.7
4	Cellulose Acetate Butyrate	Colourless	1	Nil	−11.5	—	− 7.6
		Transparent	30	Nil	− 8.0	—	− 9.2
			200	Nil	− 1.8	—	− 2.4
			400	Nil	− 7.2	—	− 7.3
5	Cellulose Acetate ..	Black	1	− 5.0	—	—	− 26.3
			7	− 8.0	—	—	− 51.0
			30	−26.5	—	—	−101.5
6	Cellulose Acetate ..	Red	1	−10	—	—	− 40.0
			7	−15	—	—	− 78.0
			30	−30	—	—	−120.0
7	Cellulose Acetate ..	Blue	1	− 5.0	—	—	− 28.0
			7	− 7.0	—	—	− 48.0
			30	−20.0	—	—	− 95.0

Table 10 deals with the severe hot dry and hot wet test conditions, and illustrates the very much better performance of cellulose acetate butyrates in every instance.

(To be continued)

Table 9.—Behaviour of Cellulose Acetate and Acetate Butyrate Tubing under Mild Humidity Test. Changes in Weight and Dimensions.

Sample No.	Material	Colour	Test Period in days	Parts per Thousand Changes in			
				Length 1	Length 2 or Dia. 1	Dia. 2	Weight
1	Cellulose Acetate Butyrate	White	1	+ 1.7	+ 0.8	—	+12.5
			30	+ 2.7	+ 0.8	—	+15.4
			200	Nil	+ 2.4	—	+14.1
			400	− 7.0	− 5.2	—	− 0.5
2	Cellulose Acetate Butyrate	Red	1	+ 2.7	+ 0.7	− 2.2	+10.5
			30	+ 2.7	+ 2.0	− 3.0	+12.3
			200	+ 2.7	+ 0.7	− 1.3	+13.4
			400	− 6.0	− 0.7	− 9.0	+ 4.0
3	Cellulose Acetate Butyrate	Blue	1	+ 1.3	+ 0.7	—	− 7.7
			30	+ 2.0	+ 3.7	—	+11.1
			200	Nil	+ 5.0	—	+12.4
			400	− 3.5	+ 2.5	—	+ 2.7
4	Cellulose Acetate Butyrate	Colourless Transparent	1	− 5.0	+ 4.0	—	+15.2
			30	− 5.0	+ 1.8	—	+16.3
			200	− 5.0	− 1.8	—	+18.4
			400	− 5.0	− 1.8	—	+ 9.0
5	Cellulose Acetate ..	—	1	− 5.0	—	—	—
			7	−20.0	—	—	—
			30	−35.0	—	—	—
6	Cellulose Acetate ..	—	1	− 5.0	—	—	—
			7	− 5.0	—	—	—
			30	−25.0	—	—	—
	Cellulose Acetate ..	—	1	− 5.0	—	—	—
			7	−20.0	—	—	—
			30	−33.0	—	—	—

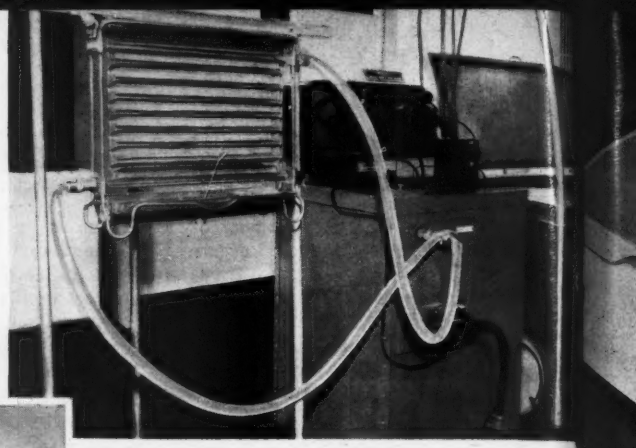
Table 10.—Behaviour of Cellulose Acetate and Acetate Butyrate Tubing under Cyclic Hot Dry and Hot Wet Conditions. Changes in Weight and Dimensions.

Sample No.	Material	Test Conditions	Parts per Thousand Changes in			
			Length 1	Length 2 or Dia. 1	Dia. 2	Weight
1	White CAB ..	(a) Dry Heat at 70° C.	− 4.3	− 4.0	—	− 9.5
		(b) Wet Heat at 55° C.	+ 4.0	+ 6.7	—	+19.5
		(c) Wet Heat at 55° C.	+12.0	+ 6.7	—	+19.5
2	Red CAB ..	(a) Dry Heat at 70° C.	− 0.7	− 0.7	+ 4.0	− 8.0
		(b) Wet Heat at 55° C.	+ 5.3	+ 5.3	+ 5.6	+19.5
		(c) Wet Heat at 55° C.	+ 6.0	+ 5.3	+ 8.3	+19.5
3	Blue CAB ..	(a) Dry Heat at 70° C.	− 2.0	− 0.8	—	− 8.0
		(b) Wet Heat at 55° C.	+ 5.3	+ 7.0	—	+18.2
		(c) Wet Heat at 55° C.	+ 5.3	+ 7.8	—	+19.0
4	Transparent Colourless CAB	(a) Dry Heat at 70° C.	Nil	− 3.6	—	− 8.0
		(b) Wet Heat at 55° C.	Nil	+ 3.6	—	+23.5
		(c) Wet Heat at 55° C.	− 5.0	− 1.8	—	+23.5
5	Black CA ..	(a) Dry Heat at 70° C.	− 9.0	—	—	−30.0
		(b) Wet Heat at 55° C.	+ 8.0	—	—	+40.0
		(c) Wet Heat at 55° C.	+18.0	—	—	+65.0
6	Red CA ..	(a) Dry Heat at 70° C.	−10.0	—	—	−45.0
		(b) Wet Heat at 55° C.	+10.0	—	—	+58.0
		(c) Wet Heat at 55° C.	+16.0	—	—	+74.0
7	Blue CA ..	(a) Dry Heat at 70° C.	− 8.0	—	—	−30.0
		(b) Wet Heat at 55° C.	+ 6.0	—	—	+32.0
		(c) Wet Heat at 55° C.	+20.0	—	—	+71.0

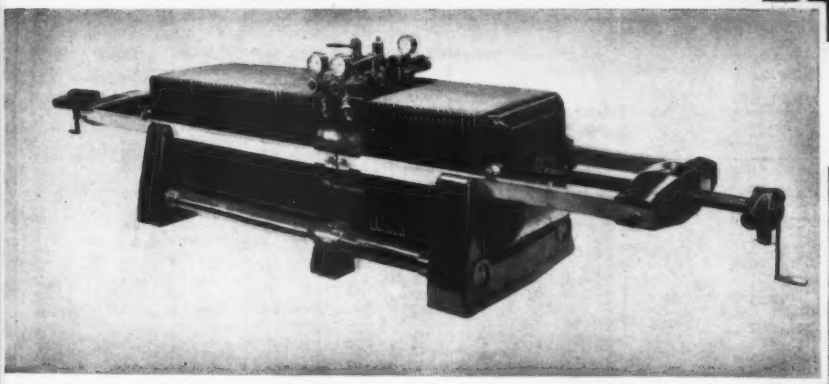
PLASTICS
IN THE SERVICE OF MAN

A pictorial review of high-quality units moulded or otherwise fabricated in Great Britain . . .

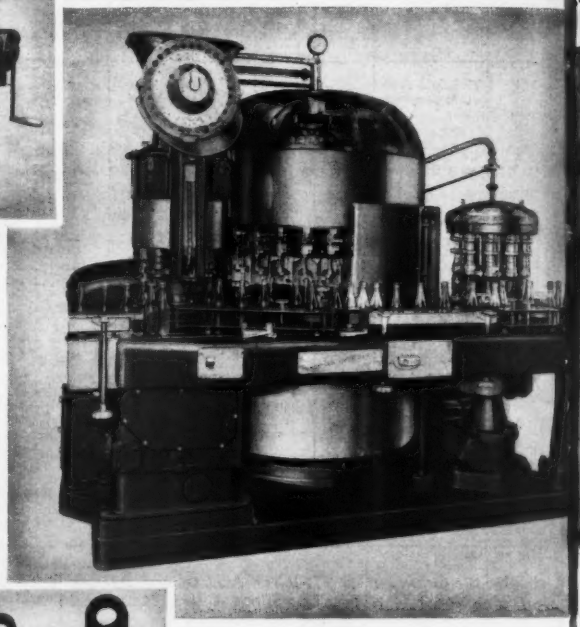
35. Food Production—II



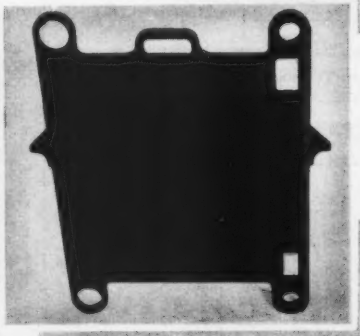
(Above) Extruded p.v.c. tubes, translucent and non-toxic, have replaced rubber tubes on the "Prestcold" series milk cooling units manufactured by Pressed Steel Co., Ltd.



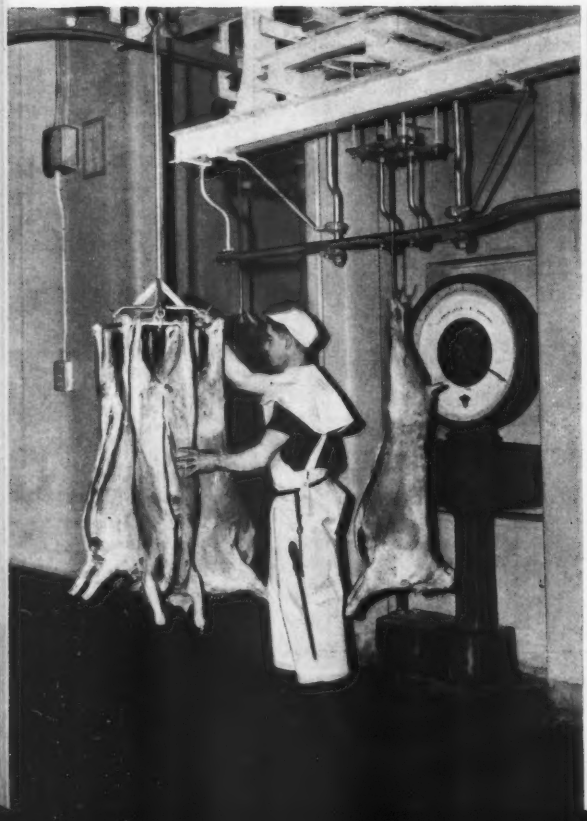
(Above) Moulded plastics filter plates have shown many advantages over metal plates, in the "Superite" sheet filter for the filtration of beer, cider, vinegar, manufactured by G. J. Worssam and Son, Ltd.



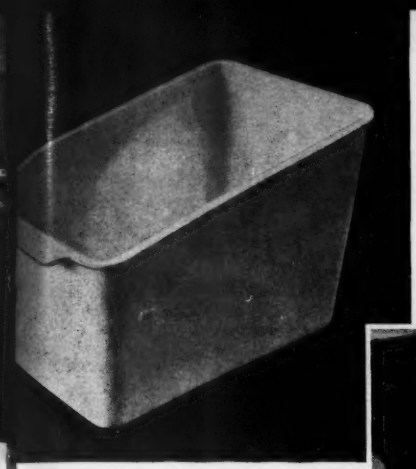
(Right) Domed guards of transparent "Perspex" are used to keep dust from the soft drinks filling machine manufactured by G. J. Worssam and Son, Ltd.



(Left and below) This filter (below), made by British Filters, Ltd., for the brewing industry, employs filter plates made from a plastics material specially developed to withstand sterilization and the materials being filtered.

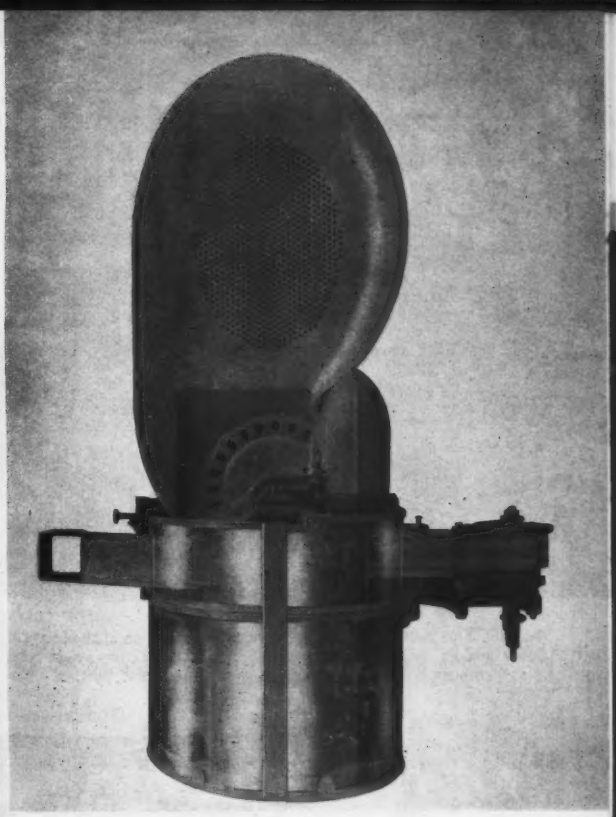


(Left) Operatives at the Guildford Experimental Slaughterhouse of the Ministry of Food wear hygienic protective clothing made from plastics-coated material. (Photo: Ministry of Food.)



(Left) Washable and unbreakable drip trays moulded in polythene by J. F. Kenure, Ltd., are used (in place of enamelled metal) with beer pumps.

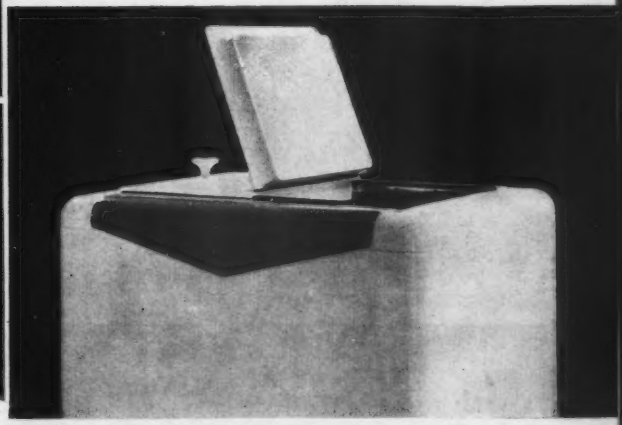
(Below and right) A screen of opaque vinyl sheeting enables workers at this egg packing station to inspect and grade eggs by "candling" without interference from daylight.



(Above) Bird's-eye view of the confectionery twist-wrapping machine manufactured by Rose Bros. (Gainsborough) Ltd. Working parts are protected by hinged "Perspex" guards.

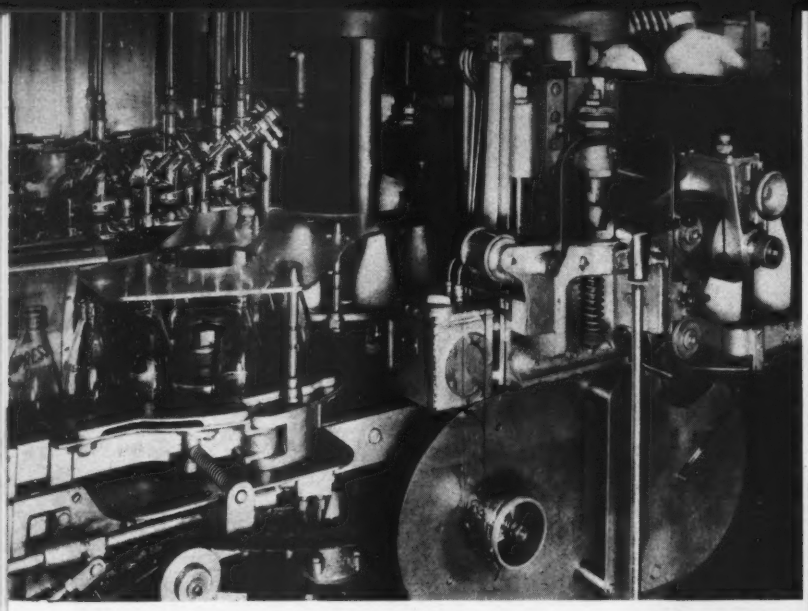
(Below) This ice-cream or frozen-food cabinet manufactured by L. Sterne and Co., Ltd. has a hinged double lid moulded in white polystyrene, and two curved polystyrene plates bearing the trade name "Sternette" to protect the edges.

(Right) "Pliofilm," transparent rubber hydrochloride film manufactured by Goodyear Tyre and Rubber Co., Ltd. has been used for experimental milk-bottle caps.



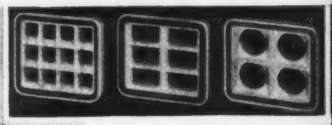
(Below) Preparation tables at the sausage-making factory of Hughes Bros., Aintree, have been veneered with "Formica" plastics laminates, manufactured by Thos. De La Rue and Co., Ltd.

(Below) Quick-frozen game and poultry is packed by Pettits of Reesham, Norfolk, in "Alkathene" extruded polythene film tubing. (Photo: I.C.I.)

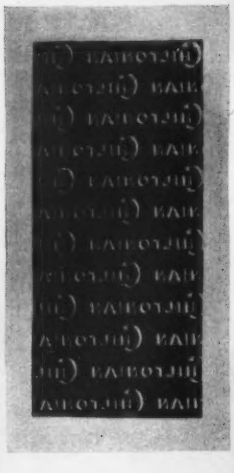


(Above) This milk-bottle filling and capping machine at the Express Dairy makes use of a transparent "Perspex" cover over the conveyor to ensure that no dust enters the bottles.

(Above) Snown shaped ice lo are made using p thene moulds, i tion - moulded J. F. Kenure, for Aero Pipe Glass Co., Ltd. deep "Perspe tray serves to uni a set of fro "lollies."

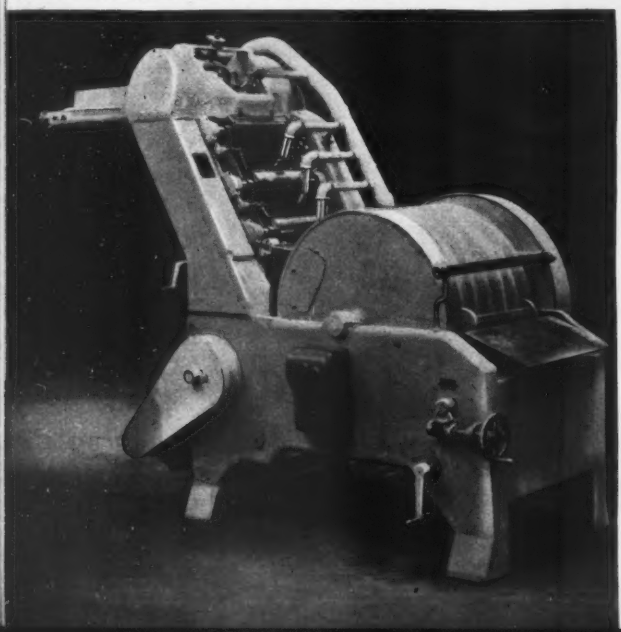


(Left and above) In this butter patter manufactured by Euk Catering Machinery, Ltd., cream urea mouldings are used for the dies (above), container and all other parts in contact with butter.



(Above and left) An endless p.v.c. belt, embossed with the trade mark "Chiltonian" (see insets) conveys biscuits from a chocolate enrober to a cooling tunnel at the factory of Chiltonian, Ltd. The belting is manufactured by Arlington Plastics Development, Ltd.

(Below) Two large acrylic sheet pressings fabricated by Thermo-Plastics, Ltd., form the containers and surround for a frozen-food display cabinet.



(Left) The "Duro" rotary moulding machine for bakeries, manufactured by Thomas Barker and Sons, Ltd., employs three sets of "Fluon" (p.r.f.e.) covered rollers for shaping loaves. This material prevents dough from sticking to the rollers

Machinery at the German Plastics Exhibition

In the December issue of "Plastics" we described some of the materials and products displayed at the German Plastics Exhibition held at Düsseldorf last October. Some information about the German plastics machinery which was demonstrated is given below.

Injection Moulding Machines

There was little to be seen which showed marked superiority of German injection machines over their British counterparts. In general, the platen area and daylight size were no greater than comparable British machines, and the production cycles were similar.

Hahn and Kolb have two machines available. The larger one can be automatic, semi-automatic or manually operated. A still larger machine is at present under construction.

Eckert and Ziegler demonstrated some of their range of injection machinery, which is noted for its robustness. Unlike many other German manufacturers, they do not appear to have considered streamlining necessary.

The "Hyprima" injection machine, made by Bekoma, has a shot capacity of 120 gms. (4.2 oz.). The shots are controlled by an automatic weight regulator instead of the usual volumetric type. A fan mounted on the hopper blows hot air from an electric element through the moulding powder to dry and preheat it.

Extruders

Johann Fischer showed two single-screw extruders. One has a screw diameter of 32 mm. and the other 50 mm. They can be supplied with downhead dies for nylon extrusion. A demonstration was given of two-colour p.v.c. extrusion by means of two extruders coupled to a single die. It is claimed that p.v.c. containing only 3 per cent. plasticizer can be extruded from these machines.

Another single-screw extruder, made by Heinrich Koch, excited some interest. It is available in four sizes, all fitted with single screws which, it is claimed, will deal with polyamides and unplasticized p.v.c. satisfactorily. The heating of the cylinder is by oil and the speed of the screw of the smallest machine can be varied from 6-70 r.p.m., and that of the largest machine (the HKS 120) from 4-50 r.p.m.

Kleinewefers exhibited a range of single-screw machines the largest of which has a screw of 120 mm. diameter.

The Eck double screw extruder was novel in the construction of the screws It is claimed that the centre section of each screw gives the polymer a similar treatment to that received in a Banbury mixer.

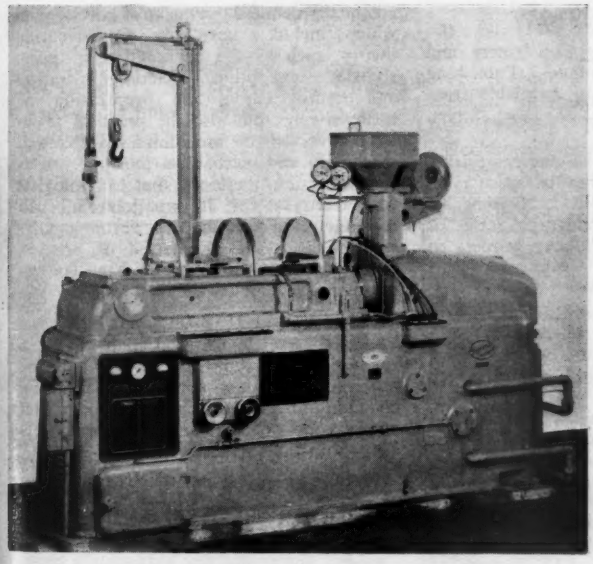
Other companies exhibiting extruders with two or more screws were Leistritz and Hamburger Eisen und Bronzewerke A.G.

The Leistritz machine has, in fact, four screws and is available in four sizes. Demonstrations were given of these machines producing p.v.c. chips from a polymer/plasticizer premix.

Hamburger Eisen und Bronzewerke A.G. had on show a double screw extruder which can be used for compounding and extrusion. The screws are easily removed and the speed is stepless variable between 10 and 60 r.p.m. The motor is 11 h.p. There are three heating zones on the barrel, one on the head and one on the die. There are five cooling zones on the barrel and one on the head. The screws are also fitted for cooling. The feed hopper is fitted with a mixer arranged so that the material is lifted up to allow air to escape from the feed. The control panel is fitted with a screw device for temperature control and the current control for heating is arranged so that it can cut out at regular intervals between 1 and 17 secs. This cut-out can, of course, be preset.

Demonstration of welding rigid p.v.c. at the Düsseldorf exhibition.

Other machines manufactured by this company include twin rolls, calenders, strainers, tyre-making machinery and presses. The tyre-building machines, incorporating the "high-shoulder" centrifugal drums, are particularly interesting, as it is possible to make the drums collapse, even at crown heights above 2 ins., without detaching shoulder parts.



"Hyprima" injection-moulding machine. (Bekoma)

Calenders and Mixing Rolls

Many of the companies who have been mentioned above exhibited not only extruders but also calenders and rolls. Amongst the firms which have not already been mentioned are Berstoff and Dornbusch.

The calenders and rolls made by Berstoff can be supplied for almost any polymer. The rolls, on one of their four-bowl calenders, are arranged vertically and each is driven by its own electric motor to ensure infinitely variable friction ratios between any pair. A special device is fitted to most of the equipment in this class to ensure easy changing of the bowls. This is considered an important point by p.v.c. manufacturers.

Dornbusch are one of the most famous companies in the world for the manufacture of embossing machinery. The effects obtained with some of their equipment are most striking.

A range of plastics extruders exhibited by Joh. Kleinewefers Söhne.

Miscellaneous Equipment

Heraeus of Hanau demonstrated their high vacuum equipment and showed samples of plastics, fabrics, leathercloth and glass which had been metallized by vacuum deposition. It is understood that this company have a considerable amount of knowledge on the protection of the metallic deposit to prevent corrosion and wear. The necessary information is supplied to purchasers of their equipment.

Sack and Kiesselbach manufacture hydraulic hobbing presses in five different sizes. All presses are fitted with two guards having Plexiglas observation windows. These are readily rotatable about the axes of the presses and are spring suspended. The pressure plate is of steel with a strength of 51 t.s.i. as a protection for the end plate. It is retained in position by dowel pins.

The measuring equipment is fitted with two vernier scales and a large-dial indicator. When the predetermined depth of impression has been reached there is an automatic changeover from continuous to tracer control.

Carl Canzler demonstrated the application of the Schoerg system of induction heating for resin kettles. This system of heating is claimed to give precise temperature control to an accuracy within about 1 degree C., ensuring a high degree of uniformity for repeat batches of polymer.

Alpine and Condux showed a range of grinding equipment. Alpine have upwards of a dozen machines for the grinding of raw materials. In one of their catalogues is a diagram detailing the type of materials which can be ground, to what particular size, and the type of machine to accomplish the disintegration. It is claimed that in one of the Alpine machines resins can be pulverized with little residue down to 200 to 250 mesh, and soft, dry materials down to 1-10 μ.

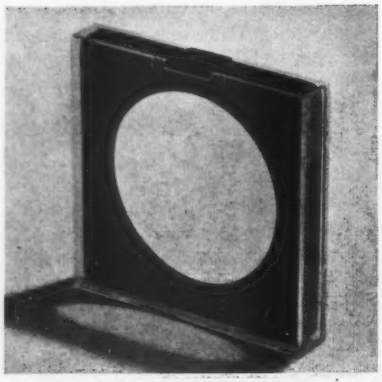
Testing Equipment

Zwick and Co. demonstrated their testing equipment, which is suitable for the physical testing of plastics. Amongst the items shown were abrasion testers, hardness testers, universal testing machines (suitable for tensile, compression and bending tests, etc.), and a number of impact testing machines with interchangeable pendulums.

The Brabender instruments are well known to some research and development laboratories in Great Britain. Their plastograph is used for evaluating structural changes of viscous materials brought about by kneading either at a constant or variable temperature within a range of 20 degrees C. to 80 degrees C. The machine can be specially constructed for temperatures up to 200 degrees C. and special kneaders can be supplied to suit the properties of the material under test. The Brabender Viscograph is used for determining the viscosity of polymeric materials, and as it is not based on a static method it allows the structural changes of the material during all stages of the test to be followed.

Conclusions

The main object lesson to Great Britain of the exhibition was in the field of industrial utilization of synthetic resins. It showed also that, in order to meet the growing challenge from abroad we must look to our laurels in the development of new materials and make ourselves more self-supporting in the production of the old.



COIN DISPLAY CASE

The transparent plastics case for the 1953 Coronation five-shilling piece, designed and manufactured by Lacrinoid Products, Ltd. Approximately 2 ins. square, the transparent slip-on cover is made of polystyrene; an inner black tray is made from urea formaldehyde. Designer is Rodney Hooper, M.S.I.A., Lacrinoid Products, Ltd.

Book Review

"Styrene, its Polymers, Copolymers and Derivatives." Reinhold Publishing Corporation, U.S.A. Available from Chapman and Hall, 37, Essex Street, W.C.2. Price 160s.

To review in detail a volume comprising some 1,300 pages in a limited space is to accomplish the impossible. "Styrene," a new addition to the Monograph Series of the American Chemical Society, borders on the encyclopædic in its treatment of this group of plastics materials.

Its appeal will, of necessity, be limited in the first instance to the scientist who has long awaited a reliable and comprehensive reference work in this field. From the very detailed bibliographical references it is evident that the authors have scrutinized exhaustively the periodical and patent literature to achieve this end. 300 pages are devoted to the manufacture, the physical properties, chemical analysis, handling, and use of styrene monomer.

Balance has, however, been preserved by an equally detailed treatment of polystyrene, which includes not only the scientific theory, such as the degradation of polystyrene, substitution, including nitration and hydrogenation, the preparation of methylstyrene, but also the practical problems involved in mouldings, fabrication, machinery and mechanical finishing. It is to this section, therefore, that technologists will refer to for information on such manufacturing procedures as forming polystyrene sheet, the orientation of bristles, fibres and films, adhesives, and the colouring of polystyrene by its moulder.

Edited by Ray H. Boundy and Raymond F. Boyer, the book is fundamentally a symposium contributed by some 20 authors; nevertheless, it does not share the failing common to the majority of such works, that of unevenness of style and degree of coverage within the various sections.

Worthy of special mention is the survey of patent literature relating to styrene and its copolymers, covering 96 pages and some 900 patents.

World's Industry Employs Plastics

INDUSTRIAL APPLICATIONS

Plastic foil stops leakage.—Lost circulation in oil drill holes is restored by "Jellflake" cellulose-foil material with very high surface area per unit weight; it maintains high strength, even when wet. ("Oil and Gas Journal," 1951/Sep. 29/279.)

Plastics at work.—P.T.F.E. bellows connector, nylon motor insulating shells, glass-bonded mica sockets, plastic aircraft wiring insulation, phenolic fuse plugs are among new items described in an American contemporary. ("Materials and Methods," 1952/Sep./110.)

Plastic prototypes.—W. A. Stanley read a paper at the S.A.E. Summer Meeting, 1952, on the use of plastic prototypes in preparation for manufacture. ("Machine Design," 1952/Oct./301.)

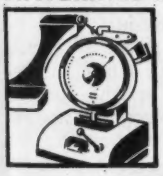
Polyethylene stripping shapes.—For stripping zinc deposits from aluminium cathodes extruded channel shapes of polyethylene are used instead of wood. ("Materials and Methods," 1952/Sep./108.)

Butyrate pipe fittings for diameters from ½ in. to 4 ins. have been developed. The fittings are quickly and permanently joined to the pipe by a solvent cement. ("Materials and Methods," 1952/Sep./109.)

Car body materials.—A highly technical discussion took place at the annual meeting of body engineers in Detroit. Greater concentration on the fundamental application of plastics became evident. Tables of physical properties of plastic body laminate and of "Royalite" are given. ("Autom. Industries," 1952/Dec./70.)

Plastic foam as a substitute for ribs.—"Styrafoam," a hard polystyrene foam, is used as an inner filler for control suffaces; 80 per cent. of rivets can be saved. ("Autom. Industries," 1952/Dec./92.)

MATERIALS and TESTING



Testing of soft rubbers and soft p.v.c. — The Swiss Association for Material Testing publishes a V.S.M. draft dealing in particular with the tensile test. ("Schweizer Archiv f. angew. Wiss. and Technik," 1952/Oct./344.)

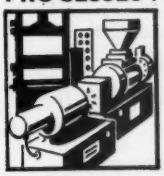
Influence of manufacture on permanence of plastics has been investigated by J. L. Williams and J. W. Mighton. Properties of unstable mouldings will change with time or when exposed to extremes of temperature. (A.S.T.M. Preprint No. 139, 1952.)

Gasket materials.—S. G. Kelley surveys the properties and uses of these parts, for which a wide assortment of synthetic and natural materials is available. ("Materials and Methods," 1952/Aug./108.)

Impact strength of plastics.—W. Schack shows how impact strength should be measured and what the results mean. ("Machine Design," 1952/Nov./159.)

Flame retardant.—New resin whilst easy to punch and machine gives increased safety. Retardant extinguishes flame much faster than untreated plastic. ("Electrical World," 1952/June/131.)

PROCESSES : MACHINERY



Preparing production of plastic mouldings.—D. A. Dearle shows that careful planning is necessary to prepare for long production runs, to avoid costly delays during the run. ("Production Engineering and Management," 1952/Nov./50.)

Finishing of plastic mouldings.—A. Reichberger discusses the problems in the finishing of plastics: placing of the flash, finishing by cutting and grinding and polishing. ("Betrieb and Fertigung" (Vienna), 1952/Vol. 6/161.)

Development of a new plastics diffuser.—F. Magyar and P. Moussong describe the injection moulds developed for a plastics diffuser nozzle. Injection moulds for single and two parts are shown. ("Betrieb and Fertigung" (Vienna), 1952/Vol. 6/157.)

Machines for the plastics industry.—Mixing and sheeting mills, extruders for polyvinyl chloride and other plastics, as produced by Reed Bros. (Engineering), Ltd., London, E.14, are described. ("Machinery Lloyd" (European edition), 1952/Nov. 15/72.)

COATINGS and ADHESIVES

Deck Coverings.—Use of rubber latex based flooring compositions are light, non-slip and hard wearing. Applied directly to steel plates they save weight and installation costs and prevent corrosion of the metal structure. Thermoplastic resin-bonded tiles are widely used in passenger ships and crews' quarters. ("The Syren and Shipping," Illustrated Supplement, 1952/Sep. 24/23.)

A corrosion-resistant single-coat finish has been developed by the Glidden Co., Cleveland, Ohio, for marine and farm use. One finish coat is said to replace four or five coats of paint previously applied. ("Materials and Methods," 1952/Nov./152.)

Abrasion-resistant rubber-base coating.—B. G. Floersch describes large external fuel tanks which have more than 30,000 spot welds and are covered by a smooth "aerodynamic" film. This reduces air resistance and therefore increases the speed of jet aircraft. ("Materials and Methods," 1952/Nov./184.)

MISCELLANEOUS USES

Package of abrasive.—A new plastic cartridge replaces glass cartridges hitherto used for "Dymo" diamond abrasive (Elgin Nat. Watch Co., Elgin, Ill.). It is claimed that contamination caused by minute glass chips, which may cause scratching during polishing, is eliminated. Plastic cartridge will not break or crack if accidentally dropped. ("Plastics World," 1952/October.)

Research on plastic pipes.—The National Sanitation Foundation at the University of Michigan will study the performance characteristics of plastic pipe in the transmission of water in rural supply systems. ("Mechanical Engineering," 1952/Dec./102L.)

A high-temperature metal-sealing thermosetting plastic developed by Melkor Research Lab. Inc., 11749, Detroit Avenue, Cleveland, 7, is said to withstand continuous temperatures of 392 degrees F. and also to possess high dielectric strength. Particular claims are made for hermetic sealing and gas sealing under pressure such as for perfect functioning of electrical components. ("Materials and Methods," 1952/Nov./149.)

Extruded plastics.—Flexibility and low cost account for the present interest in extruded plastic parts. Many materials can be used, such as nylon, silicone, polystyrene vinyl and celluloses. ("Product Engineering," 1952/Oct./150.)

Plastics in food industry.—K. Stoeckhert gives a survey of plastics in the food industry and deals also with domestic uses. ("VDI Zeits," 1952/Oct. 11/954.)

Plastics in interior architecture.—Whilst plastics, for technical and economical reasons, cannot yet be used externally, many applications occur in interiors and furniture. ("VDI Zeits," 1952/Oct. 11/962.)

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Moulded Flow Cups

SIR,—The use of the No. 4 Ford Cup, an accepted means of measuring the consistency of paints, varnishes and synthetic resins, is recognized by B.S. 1733: 1951, Flow Cups and their Method of Use. The Type B cup described in this specification is based on the dimensions of the Ford Cup.

Resinous Chemicals, Ltd., now announce the production of a flow cup which conforms to B.S. 1733 and is moulded from a phenolic powder. The body of the cup has all the advantages of dimensional stability and chemical resistance usually associated with phenolic moulding materials and a robust but accurate orifice of diameter 0.156 ± 0.0005 in. has been achieved by using a brass insert which is machined to within the close tolerances of the specification. The moulded cups may be used in place of the conventional metal cups for all normal purposes.

We feel your readers will be interested to learn that such cups may be obtained, free of charge, by authentic users on application to the undersigned.

RESINOUS CHEMICALS, LTD.
Blaydon, Co. Durham.

Plastic-lining of Oil Tanks

SIR,—Can you inform me if the British plastics industry has any experience of coating gasoline and oil tanks against corrosion?

In the June issue of the American publication "Corrosion" is given a report on experiments made over there since 1943 on board tankers. Some 500 coating materials have been tested and one of these consisting of vinylidene chloride/acrylonitrile copolymer has been found quite successful.

I understand that a probably similar plastic coating has recently been applied to the cargo oil tanks of a tanker built in Europe.

This field of plastic coating of gasoline and oil tanks is, of course, of great importance. I should therefore like to know if you are aware of any British maker producing such a material.

Norway. W.J.

Plastic Chessmen

SIR,—We inquire whether you will be good enough to give us the names and addresses of firms who manufacture plastic chessmen.

L. KAHN MANUFACTURING CO., LTD.
527-533 Harrow Road,
London, W.10.

Polyester Resins

SIR,—Your Editorial, Vol. XVII, No. 184, November, 1952, interests me. Under the heading "Glassfibre Laminates" you say it is less than 12 years ago that a representative of a Canadian firm visited your offices etc., with a resin that became famous as the first of the polyester resins.

I well remember somewhere about the year 1925 these resins being in regular production. Perhaps this is news to you. At the time I was with B.T.H., Rugby.

L. M. T. BELL,
(United Moulders Limited).
Van Lane,
Fernhurst,
Nr. Haslemere, Surrey.

[EDITOR'S NOTE: Our old friend Mr. Bell is probably chemically correct as we are sure he is referring to the production of glyptal resins, now called alkyds, for use as surface coatings.]

P.v.c. Manufacturer

SIR,—In the article "P.v.c. Sheet Shows Its Medals" which appeared in your November issue, there is a reference to a third manufacturer of p.v.c. resin shortly going into production.

We should be very much obliged if you could let us know the name and address of this manufacturer, as we would like to approach them with a view to obtaining eventually offers of material.

SALMON AND CIA., LTD.
Rua do Arsenal, 54-3°,
Lisbon, Portugal.

Toughness of Polythene

SIR,—In your December edition of "Plastics" you published an article on "Using the Toughness of Polythene." We noticed that you mentioned the following two firms: Fibrenyle Ltd., Tamworth Plastics, Ltd. Will you please have the kindness to indicate to us the exact addresses of these manufacturers.

Kornhausbrucke 5, VERRIT SA.
Zurich 31.

[EDITOR'S NOTE: Fibrenyle Ltd., 157 Dukes Road, Western Avenue, London, W.3. Tamworth Plastics, Ltd., Alders, Tamworth, Staffordshire.]

Plastics Letters

SIR,—We have been recommended to write to you for information regarding any firms who you think may make 3-in. white plastics letters with screw-holes. So far we have been unable to find any firms who do this work and would appreciate your assistance.

RAYMOND CAUDWELL, LTD.
Estate Offices,
North Cotes, Grimsby.

Beryllium-copper Moulds

SIR,—With reference to the short note which you published ("Plastics," December, 1952, p. 363) in connection with the use of beryllium-copper for moulds, we thought you would be interested to know the most important reasons for the use of beryllium-copper cavities by the plastics industry.

1. For articles of great detail, and particularly those with uneven and intricate parting lines (such as doll moulds, toy autos, etc.), it is much cheaper to cast beryllium-copper then polish and fit, than it is to cut the entire cavity from a solid block of steel.

2. The high thermal conductivity of beryllium-copper allows the heat from the molten plastic to escape more quickly from the cavity, thus enabling the injection machine to be operated at an advanced rate.

3. By means of pressure-casting it is possible to obtain a large number of cavities from a male master which is usually much easier to machine than the female cavity. Also this process ensures a fine finish which requires little or no polishing.

4. Beryllium-copper can be hardened to Rockwell C-45 at the low temperature of 600 degrees F., which ensures no distortion due to heat treatment.

5. The elastic properties of hardened beryllium-copper eliminate the denting and scuffing so often encountered in case-hardened cavities, when a bit of scrap or flash plastic is pressed in the cavity or landing.

6. The history of beryllium-copper cavities in the United States has proved that they outwear steel and to a much greater extent hardened iron hobbings. The finish obtained on the plastic piece has proved superior to that obtained from steel cavities.

BERYLLIUM SMELTING CO., LTD.
36-38, Southampton Street,
London, W.C.2.

Embedding Resins

SIR,— We would like to enquire if you can put us in touch with a firm supplying a clear-setting resin suitable for setting small scientific objects or natural history subjects such as beetles, etc.

BROWNING'S LABORATORY AND SUPPLY CO., LTD.
69 Aberdeen Street,
Hull.

[EDITOR'S NOTE: Imperial Chemical Industries Ltd., Plastics Division, Black Fan Road, Welwyn Garden City, Herts. Scott Bader and Co., Ltd., Wollaston, Wellingborough, Northants.]

New Films, Sheet and Fabric

"TERYLENE" FILM

Imperial Chemical Industries, Ltd., hold the world rights outside the U.S.A. for the manufacture of "Terylene" polyester film. Laboratory work on its manufacture has been carried out by the Plastics Division, Welwyn Garden City, who are responsible for its development, and a pilot plant will be in operation this year. No film will be available until the middle of the year, when small quantities for appraisal by industry will be released. Bulk quantities will not be available until a large-scale plant is in operation.

The film is produced by a melt casting technique. As the viscosity of molten "Terylene" is about a fifth of that of the usual grade of polythene, the process calls for great accuracy of die manufacture and close control of temperature and die pressure. No additives whatsoever are added to the polymer during film making and the finished film is glass clear and possesses a glossy surface. The cast film, however, has a relatively low yield point and is thermally unstable, so that subsequent processing is necessary to convert it into a marketable material. This consists of drawing the film in two directions at right angles, which improves the mechanical properties of the film equally in all directions, and finally "heat setting" the film by holding it in such a way that it cannot contract and heating it to temperatures of around 200 degrees C. The final film is extremely strong and tough and is thermally stable up to the setting temperature.

Very thin gauge film can be made. It is expected that 0.0003-in. film will be available from the pilot plant; this material is quite tough and comparatively easy to handle.

Properties of "Terylene" Film

General

Specific gravity ...	1.39
Area factor sq. in./lb./0.001-in. ...	20,000
Water absorption % by wt., prolonged immersion in water	0.5
Water permeability 38°C. 90% R.H. gm./sq. m/day/.001%	30

Thermal

Melting point °C. ...	265
Temperature at which film flows under stress of 2,000 p.s.i. °C. (sag temperature) ...	180-190
Inflammability ...	Ignites and burns with difficulty. Passes B.S. 850. (1939).
Low temperature flexibility	Remains flexible at −50°C.

Mechanical

The film has balanced properties in all directions and no difference in properties can be detected when conditioned and tested at humidities between 70 and 100 per cent. R.H.

Yield stress at break p.s.i.	14,000
Tensile strength p.s.i.	25,000
Elongation at break %	50
Tear resistance Elmendorf gm.cm/cm tear/.001-in. thick.	120
M.I.T. Folding Endurance ...	No detectable damage after 100,000 cycles.

Chemical Resistance

Good resistance to mineral acids, including concentrated phosphoric acid, but decomposed by concentrated sulphuric. Moderate resistance to alkalis, excellent to oxidizing agents. Excellent to organic compounds with the exception of phenols and chlorinated phenols.

Electrical Properties

Dielectric strength volts/0.001-in ...	4,500
Volume resistivity ohm/cm	1017
Dielectric constant 60 cycles/sec. ...	3.1-3.2
1,000 cycles/sec.	3.1-3.2
10^6 cycles/sec. ...	3.0-3.1
Power loss factor 60 cycles/sec. ...	0.002
1,000 cycles/sec.	0.004-0.006
10^6 cycles/sec. ...	0.013-0.015

It is expected that the thin gauges of film will find applications in a number of specialized fields, such as the manufacture of adhesive tapes, etc., and also in the electrical industry. Its use in electrical equipment will enable the bulk of insulation to be reduced and make possible the use of higher working temperatures.

For packaging, the high clarity and toughness of the film would be very attractive. It may eventually be possible to produce a photographic base film from "Terylene."

"MYLAR" FILM

The Du Pont Company have announced that it will start construction early next year on a plant south of Circleville, Ohio, for manufacture of "Mylar" polyester film. The plant, which will be operated by the company's film department, is expected to go into production early in 1955.

"Mylar," an entirely new film with unusual strength, heat resistance and insulating qualities, was developed by Du Pont through one of its fundamental research programmes. The development was announced last January. In its transparent form, "Mylar" looks like Cellophane. It is in no sense a substitute for Cellophane, however, but an entirely new product with distinct properties which appear to make it suitable for a series of new industrial uses.

Studies indicate that "Mylar" is a versatile material that will find major uses in different fields from those for which "Cellophane" and other commercial films are most suitable. Because it has great strength and excellent electrical properties, which remain relatively constant over a wide range of temperatures and humidities, its most promising immediate field appears to be electrical insulation, in such applications as motors, condensers, cables, coils and transformers.

Also, it should widen the uses of tapes for carton-strapping, reinforcement, and other industrial applications, and is promising as a base for long-lasting magnetic sound-recording tape. It is expected to be laminated with other materials, and may be metallized by depositing a microscopically thin layer of aluminium or other metal on it. Other uses, which will require further research and development, include packaging and plastic glazing.

"STYRON 475" SHEET

We have received details of a rigid thermoplastic sheet developed for heat forming and drawing methods of fabrication and produced by the Dow Chemical Corporation. Supply is limited by production and dollar licence, but we understand that sheets are manufactured 40 by 72 ins. in three gauges, 0.040 ins., 0.060 ins. and 0.080 ins. Non-standard sheets are also made. Standard colours are white and green, others being available against large orders.

Advantages claimed include very good physical properties, forming ability, electrical resistance and low cost. The sheet can be fabricated by most methods used for forming thermoplastic sheet. Fabrications show good dimensional stability and have little internal stain. The material may also be embossed, stamped, hot pressed and laminated.

Typical mechanical properties of Styron 475 sheet are as follows:

	Machine Direction	Cross Direction
Tensile strength, p.s.i.	3700	3400
Yield strength, p.s.i.	3900	3600
Elongation, per cent.	20	20
Impact strength, notched, ft.lb./in. of notch ...	0.9	0.6
Water absorption, 24 hrs.	0.1%	0.1%

Styron 475 sheet has a specific gravity of approximately 1.07. The following yield may be expected for the respective available gauges:

lb./sq. ft.	.040 ins.	.060 ins.	.080 ins.
Maximum ...	.245	.356	.467
Minimum ...	.222	.334	.445
Estimated average	.234	.345	.456

"COURLENE"

A new fabric by Courtaulds, Ltd., woven from a polyethylene yarn; highly resistant to acid, alkalies and solvents, water repellant and air breathing, has been successfully used for low-temperature filtration and sewerage filtration, and in the manufacture of protective clothing.

Boiler suits and overalls, stitched with a chemically resistant fibre, such as p.v.c. or "Terylene" offer an adequate first protection against chemical dust, vapour and splashing by corrosive liquids. The fabric is available in a number of colours, and has an extensibility of 20-30 per cent.

Extrusion of Acetate Large Sheet and Pipe—II

By E. C. BLACKARD*

The second part of this paper, presented at the Eighth Annual Technical Conference of the Society of Plastics Engineers, U.S.A., describes the equipment for extruding pipe up to 4 ins. in diameter, and gives figures of bursting pressures for extruded pipe. The process of extruding variegated strip is also discussed. The article is reprinted from the "S.P.E. Journal," March, 1952, by permission of the Society of Plastics Engineers, Athens, Ohio.

THE same need to dry the plastics material and to control temperatures applies to the extrusion of pipe as to the extrusion of sheeting. The same type of hopper dryer is used and circulating oil is the heating medium on the extruder. Electrical band, strip or inserted heaters are used on the die. Notice in Fig. 7 that a torpedo tip is used on the screw. This happens to be the screw in the machine in our laboratory, and it could as well be the slotted tip shown on the sheeting extruder. This torpedo serves to restrict the flow and maintain a back-pressure on the extruder to minimize any surging. This problem of uniform heating and even flow occurs as a problem which must be met in all extrusions.

Notice the method of handling the extruded pipe after it issues from the die. When the process was considered there were various schemes possible for cooling the extruded pipe to keep it round until it was self-supporting. A mandrel could have been used over which the pipe would be extruded and cooled with water or air. The pipe might have been extruded directly into water and chilled quickly into shape. However, it was found that the rather simple process shown gave an easier solution and a tougher pipe. The pipe is first cooled only slightly and held in shape by the three inside cooling rings. Air heated to 180 degrees F. and at 20 lb. per sq. in. pressure is supplied by a pipe running through the centre of the inside die ring to the three inside cooling rings. This heated air is also supplied to the first outside cooling ring. The three other outside rings are supplied with compressed air at room temperature. This method of cooling has proved that the heavy section is not chilled to set up strains and cause brittleness, as might be the case with other methods of cooling. The pipe is supported by the hot compressed air supplied to the inner rings. These rings are made by fastening two plates together spaced in such a manner as to leave an orifice with air escaping over their entire circumference. There are two sets of spring-loaded pull-out rolls which draw the pipe at a uniform rate through the outside cooling rings. With the internal pressure forcing the pipe to fill the outside cooling rings, a uniform outside diameter is maintained. The pipe is shown larger just prior to the outside sizing ring. This is actually the very thing that takes place in the extrusion process. It appears that trouble would be encountered in drawing the swelled pipe through the first ring, but such is not the case. The pipe is soft enough to be slightly drafted and sized.

* Tennessee Eastman Corp., U.S.A.

Unique Features

The die has unique features. It is offset for a purpose. First, the inside die rings can be held in place by the centre stud, which fits in from the back of the die. The outer ring is held by an outer clamping ring. This design allows rings of a wider range of diameters to be used than would be possible using a die fastened directly to the extruder and requiring the die rings to be bolted on from the front face of the die. The offset die permits the introduction of the heated air to the inner cooling rings without running the pipe through the path of the plastic material. This pipe is insulated from the die body to prevent the inside of the die from being chilled. This point should not be overlooked in the design, for the die would not work at all without this feature.

With this design the same die body can be used to extrude from 2-in.-diameter pipe to 6-in.-diameter pipe. By a second die body, pipe can be extruded from the ½-in. diameter up to 2-in. diameter. Two die bodies are sufficient to cover a range of pipe ½ in. diameter to 6 ins. diameter. It is interesting also to note that material flows around the die causing only one weld point.

Restriction

Another unique feature is the restriction in the die, which is the same idea as that shown on the sheeting die previously discussed. It was on this extrusion of a ¼-in. wall pipe that the idea of restriction in dies was discovered. Without such a restriction the pipe wall was filled with bubbles and voids. By

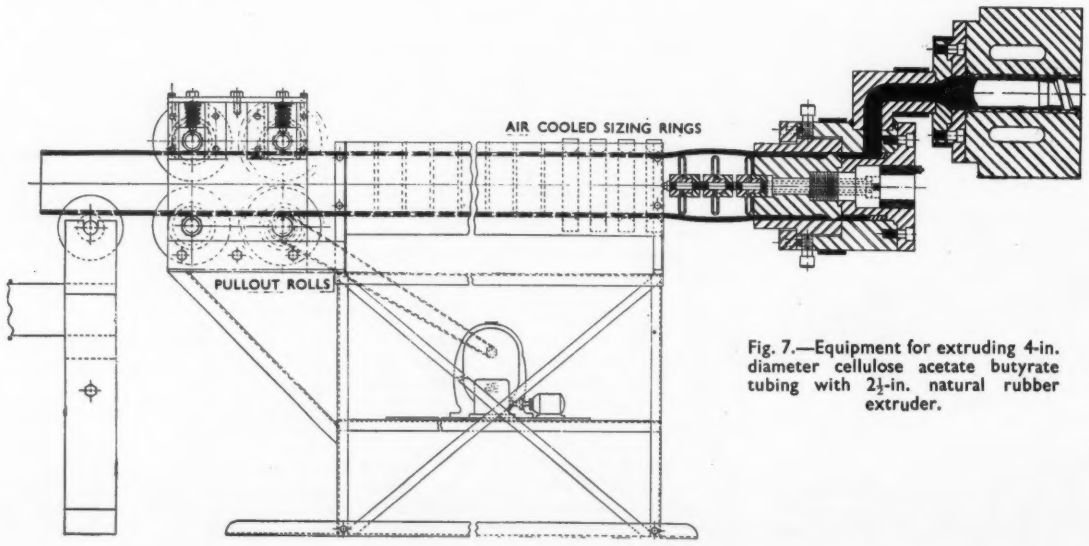
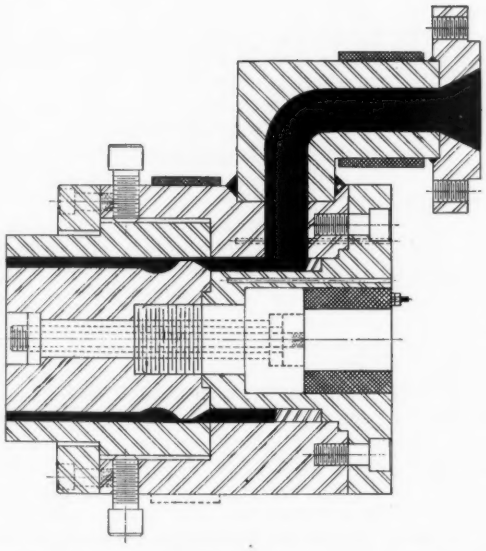


Fig. 7.—Equipment for extruding 4-in. diameter cellulose acetate butyrate tubing with 2½-in. natural rubber extruder.



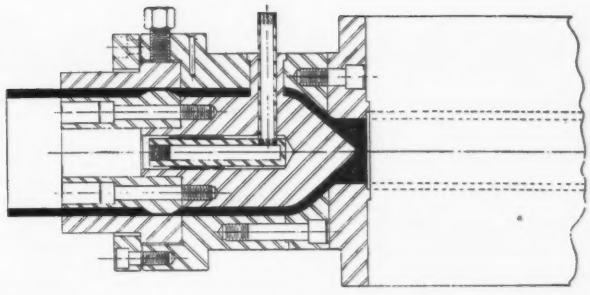


Fig. 8 (above).—Die for extruding 4-inch cellulose acetate butyrate tubing.

Fig. 9 (left).—Close-up of die used in the extrusion equipment shown in Fig. 7.

the use of the restriction these bubbles were forced out of the material to give a solid, uniform pipe well. You will also notice the long land, which bears out the general conclusion that was expressed in the extrusion of sheeting that the land must be lengthened as the thickness of the material extruded is increased.

I know that many questions occur to you when considering the merits of this process, as compared to other methods. Some have questioned the cost of using such a quantity of compressed air. It does require 100 cu. ft. per min. of free air to cool a 4-in. I.D. by 4.5-in. O.D. pipe. This would require the purchase of a $2,000 compressor, but the cost per lb. of pipe extruded to operate the installed unit would not be over a quarter of a cent. This element of cost, in my opinion, is offset by the simplicity of the operation and the assurance of obtaining a pipe relatively free from strains. I have seen very brittle pipe granulated and re-extruded to be very tough, the improvement due to nothing more than technique of extrusion without strains being set up.

The process as shown, however, is not a cure-all for strain-free pipe, and it should be recognized that, even with heated air to cause gradual cooling, care must be used to avoid strains. The least amount of air possible should be used to support the pipe and control its dimensions. It is surprising how small details can make such a great difference in the quality of an extruded product. These procedures are sometimes hidden by operators, who learn them through experience, so it is well to keep a good record of the exact methods by which satisfactory results are obtained.

The question is sometimes asked, "What are the tolerances possible in this process?" While this problem has seldom arisen on installations replacing metal pipe, I do know of one case where a 4-in. pipe was cut into sleeves to fit over a shaft. The tolerance on this job, plus or minus .015 in., was met without difficulty. A variation of not more than .030 in. in any direction can be maintained in 4-in.-diameter pipe. Of course, in smaller sizes much less variation would be possible.

I have tried to present the general problems as we recognize them in extruding the best-quality sheeting or pipe from cellulose acetate or cellulose acetate butyrate. I am forced to admit that the process must to some extent be classed as an art. All factors affecting, particularly the flow, cannot be entirely explained. This I think one must admit about much plastics processing. However, to summarize my points, it is extremely vital to dry the material and to control temperatures at all points in the extrusion. Then, as the final requirement, the material must be delivered to the die uniformly heated and at an even rate. I have placed great importance in the proper back-pressure by restrictions such as the screw tip, the screen and grid plate, the restriction prior to the die lip, and the proper land length on the die lip.

Bursting Pressure

Cellulose acetate butyrate of the formula Tenite II 205E-MH flow is generally recommended for use in pipe. This material has an ultra-violet light inhibitor incorporated to increase its resistance to light and outdoor exposure. The bursting pressures for pipe extruded from this formula are given in Table I.

A 10 : 1 safety factor is recommended between bursting pressures and working pressures. This factor should be very conservative to cover all conditions and might be less in many applications. As plastics pipe is considered for an application, until more experience is gained, it is wise to test samples to observe its performance. This can be the only sure way of determining the applications for which it is best suited. The test data, however, can be used as a guide to judge whether the application is at all practical.

Variegated Strips

For the extrusion of variegated strip we have used two extruders feeding material into one die. One is a 2½-in.-diameter National Rubber extruder used to feed a base material, for an example, a light amber. The other is a 2-in. extruder used to feed a dark filler. The objective in this process is to produce a variegated pattern comparable to the shell variegations commonly used for spectacle frames.

Using the two extruders, a variegated strip was produced but the filler was smeared in diagonal and regular stripes across the width of the strip. Also another difficulty was encountered in that the filler made a black edge on the strip as it fed across from the small extruder into the stream of base.

The black stripe was eliminated by putting a liner in the die so that the filler would be carried past the edge of the stream of base material before it extruded from a slot in the liner. The filler then

Table 1.—Bursting Pressures of Pipes Extruded from Cellulose Acetate Butyrate (Tenite II 205E-MH).

Pipe Size	Outside Dia. In.	Inside Dia. In.	Wall Thickness/In.	Bursting Pressure at lbs./sq. in		Recommended Working Pressure at lbs./sq. in.	
inch				77° F.	158° F.	77° F.	158° F.
¼	.840	.622	.109	1500	1000	150	100
¾	1.050	.824	.113	1300	800	130	80
1	1.315	1.049	.133	1250	750	125	75
1¼	1.660	1.380	.140	1050	625	105	62
1½	1.900	1.610	.145	950	550	95	55
2	2.375	2.067	.154	825	500	82	50
2½	2.875	2.469	.203	875	525	87	52
3	3.500	3.068	.216	800	450	80	45
3½	4.000	3.548	.226	725	425	72	42
4	4.500	4.026	.237	675	400	67	40

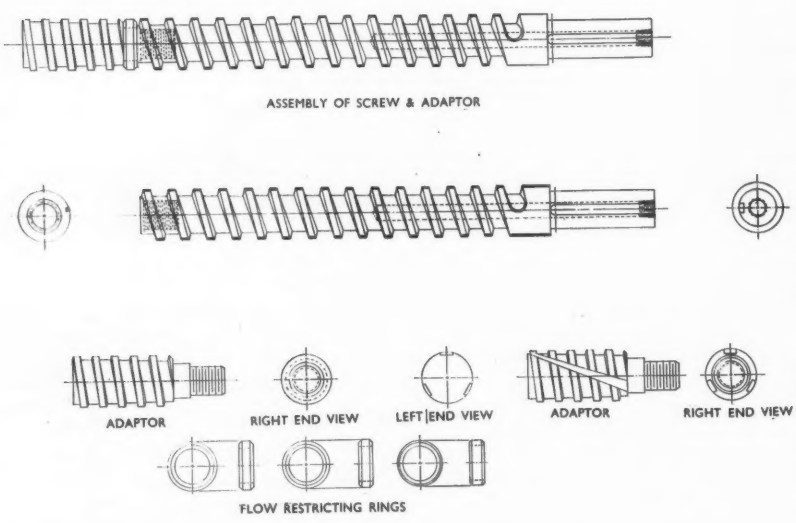


Fig. 10.—Screw designs for extruding variegated cellulose acetate strip, showing tips with slotted screw flights.

could not blacken the edge of the finished strip, but must be smeared into the base material.

To give a broken pattern of splotches of filler in the base, the screw in the filler extruder was cut off and a special tip 4 ins. long was attached. The flights on this tip were slotted, as shown in the drawing, so that small splotches of filler were delivered into the stream of base material to create a broken pattern. A number of tips were used with the flights slotted in various ways to produce varied effects. The use of tips was only done to avoid producing new screws for each trial.

The pattern can be changed by harder or softer filler, different colour of the base or filler, and by changes in the speed of the screws of either machine. Changes in the ratio of one screw speed in relation to the other will change the variegation. However, all of these variations only change the concentration of filler in the base or the number of splotches per inch. To change the orientation of the splotches in the base, the flights of the screw tip must be altered.

There is little to explain from an extrusion standpoint about the production of this variegated strip. It is certainly unique to have a process to produce continuously a variegated strip of uniform pattern and one which can be reproduced from one run to the next. Then, too, by using this idea it is possible by altered die design to extrude variegated rods. Since much of the variegated sheet material has been produced by batch pressing in the past, the development is of interest to those requiring such a product. Certainly the possibilities of producing variegated sheet stock or rods at considerably less expense can be the result of using this extrusion process. Then, too, by using this general design with alterations to the die it is possible to produce strips or rods of two or more solid colours not smeared into each other. Nothing but variegated strips have actually been produced, however, and these other suggestions are merely mentioned as being within the possibilities of the equipment and process.

Future Plans

One subject which I have not mentioned may well be a part of our future study programme, and that is to calender a sheet to improve its surface. To date much work has been done on calendering a sheet to improve its surface, or to produce a matt finish, but without success. The most encouraging results have been obtained by calendering the hot sheet as close to the orifice as possible before it has cooled. Certainly to obtain a surface as good as a cast or rolled coated sheet some method must be found to continuously impart the surface of a roll to the extruded sheet.

Work is also being done at present on a process to reinforce pipe to have it withstand greater bursting pressures and thereby broaden the field for which it can be used. The present work is being done using a fabricated glass fibre filament wrap.

The technique of extrusion of cellulose acetate and cellulose acetate butyrate is very practical as an industrial process. Many improvements will surely appear, and we plan to continue our work to that end.

Finally, I would call your attention to this fact, that the general method of mechanical and hydraulic extrusion has been practised for many years. However, none of the apparatus or methods described in the foregoing, or otherwise, should be employed without investigation of the patent situation.

This article, reprinted by agreement with the Society of Plastics Engineers, U.S.A., raises some interesting points. Readers who are interested in further drawings and detailed procedure of the techniques which have been discussed, may care to write to the Tennessee Eastman Corporation, Kingsport, Tennessee, U.S.A.

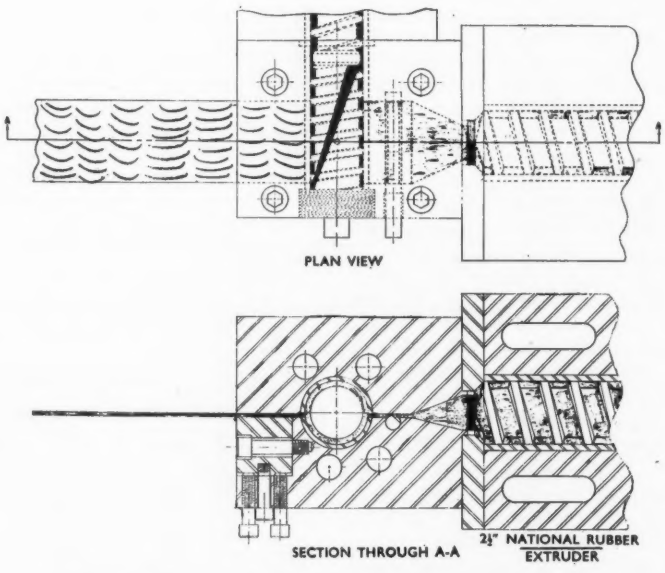


Fig. 11.—Equipment for the extrusion of variegated cellulose acetate strip showing arrangement of the two extruder screws.

Induction Heating for Synthetic Resin Plant

By O. LENHARD*

THE production of gauge-oils, esters and synthetic resins, especially alkyd resins usually requires temperatures which cannot be reached by means of the pressure steam-heating normally available. Consequently direct heating with solid, liquid or gaseous fuels, or indirect heating by heat-transmission is used for these processes. The disadvantages of direct heating are known: high temperature of combustion gases, poor efficiency, insufficient control of temperature, especially with solid fuel. Heat transmitting media avoid these disadvantages in part, but apparatus then becomes considerably more expensive and complicated. Heating with high pressure steam or hot water is rarely employed in the synthetic resin industry, as it is very expensive on account of the high pressure required for the requisite temperatures, and needs careful attendance.

The principle of induction heating is not a new one. In metallurgy induction heating in the form of high frequency heating has been applied for a long time. In the form of low frequency heating it is known as " Neiss whirl current heating " in which the induction coils are arranged on the wall next to one another. Induction heating by the Schoerg system was developed more recently, in 1928, in the former I.G. Farbenindustrie, and has there proved its great value for nearly 20 years.

The simplest application of induction heating is in wall heating. The apparatus to be heated is surrounded by a coil which is connected to normal or three-phase current. The whole forms a transformer, the primary winding of which is the coil and the secondary winding, represented by a single short circuited winding being the wall of the apparatus. At the same time the latter serves as the steel core of the transformer. Induction heating is, therefore, only applicable to apparatus made of ferro-magnetic material. If for chemical reasons non-ferrous metal has to be used, this should be clad with steel.

Current of low voltage though of very high intensity is induced in the wall by the alternating current in the primary winding, and heats the wall of the apparatus.

The advantages of induction heating are especially valuable with large output at temperatures ranging from 100 degrees to approximately 600 degrees C. With special construction even higher temperatures can be reached.

The temperature of the induction coil is the result of the combination of very low Joules Heat energy output in the conductor, of radiation and conduction of heat from the wall of the apparatus to the coil, and finally of the conduction of heat from the coil to the outside through the low insulation. Under properly regulated conditions and with correct load in the cross-section of the conductor, the temperature of the coil is no higher than the temperature of the wall of the apparatus.

Owing to this, and also because the conductors (being of large cross-section for small loads) are not liable to sparking due to fusing or breakage, induction heating is explosion-proof and can be employed in installations liable to danger of explosion.

As, further, the temperature of the coil is no higher than the temperature of the wall, the inertia of heat is small. When the current is switched off the production of heat in the wall stops immediately and completely. As a result temperature control is very precise.

Fig. 1 shows the construction of an induction heating apparatus with wall heating. The cylindrical wall of the apparatus is surrounded by two coils. The number of coils may be increased, depending on the length of the mantle. With higher output it is advisable to take three or a multiple of three in order to be able to load all phases equally. The insulation of the conductors consists of special heat resistant ceramic material. Flat iron rings are arranged between each coil for support and in order to shield their front fields. Thermo-couples are welded to the outside of the wall. Wall heating is the simplest and cheapest kind of induction heating, but flat and dished heads, plates and coils can be heated by induction as well.

Fig. 2 shows the schematic plan of induction heating developed by Schoerg. A ring box of copper is welded to the floor of the apparatus, containing a lamellar steel core with induction coils. As nearly all resistance in the secondary circuit (ring box and base of apparatus) is found in the base, it is here that the heat is produced. With this construction it is possible also to heat units of non-magnetic stainless steel; the advantage here is the power factor, cos ϕ = 1, o. Floor heating is required especially where the level of the liquid drops during the process, for instance, in distilling down to small quantities.

*Transmitted by Carl Canzler (London) Ltd., Victoria Street, London, S.W.1.

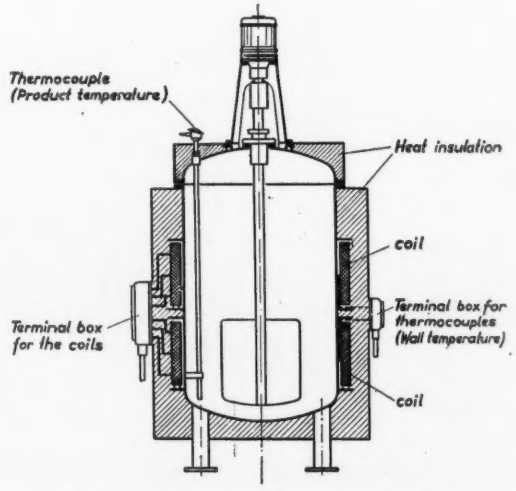


Fig. 1.—Induction heating apparatus with wall heating.

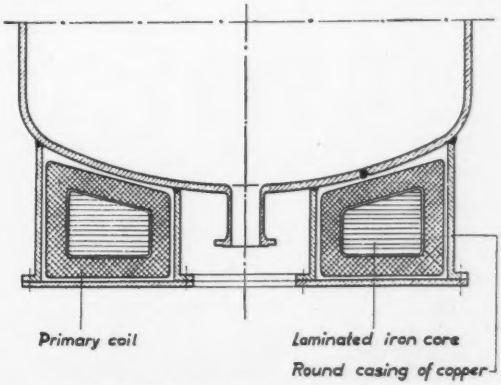


Fig. 2.—Schoerg induction heating system.

The inductive through-flow heater is particularly suitable for continuous processes. An example of this type of construction is shown in Fig. 3. The product flows through the coils which here form the secondary coil of the transformer. This is especially suitable for very high pressure.

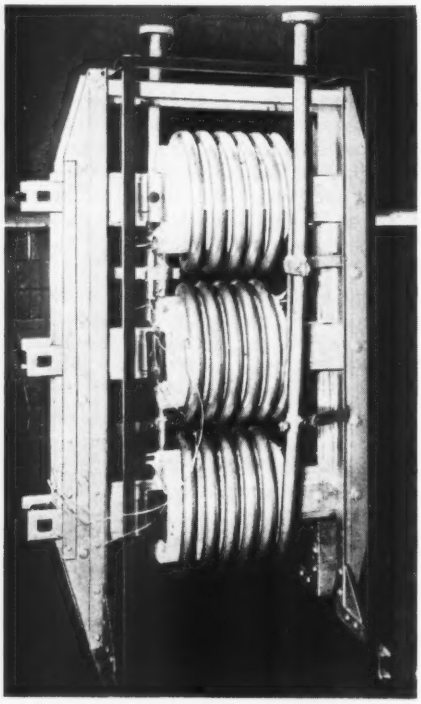


Fig. 3.—Inductive through-flow heater.

Induction heating has to-day reached a very high degree of perfection regarding technical performance and reliability in service. Its further development lies in the direction of a wider field of application and of its adaptation also to more difficult forms of apparatus.

The application of induction heating to chemical engineering dates from the years 1930 and 1931, when for the first time induction heating with normal frequency was used in the works of the then I.G. Farbenindustrie at Frankfurt-Hoechst. It is interesting to note that the first serious application of induction heating took place in the synthetic resin industry. In 1934-5, after preliminary experiments with a vessel of one cubic metre capacity, three alkyd resin vessels with a capacity each of 8.5 cubic metres were equipped with Schoerg induction heating system at the works of I.G. Farbenindustrie at Krefeld-Uerdingen. The output of the heating was 141 kW per vessel. Preheating was done by means of steam through a coiled pipe inside the vessel. It turned out a happy coincidence that the plating of iron with stainless steel was developed at the same time as induction heating. The pre-conditions for the application of induction heating to corrosion proof apparatus had thus been created. The vessels at Uerdingen, the first large steel-clad apparatus, were built by Messrs. Carl Canzler, Dueren/Rhineland, and were working successfully and continuously without repair until 1947.

Similar plant for alkyd resins, the Kirberg system, provided with induction heating according to the Schoerg system, has been built by Messrs. Carl Canzler since the war for several large varnish factories. Fig. 4 shows plant of 3,000 kg. working charge.

The small capacity of heat favours temperature control as well as any cooling process necessary. Once the current has been switched off, the induction of heat in the wall ceases immediately and, thanks to the low capacity of heat, the product in the vessel can easily be cooled by a suitable cooling device. For this, a water-cooled coil inside the vessel has proved most effective. The temperature of the contents of the 300 kg. vessel dropped, for instance, from 370 degrees to 95 degrees C. within about half an hour. Intensive stirring by means of a blade-stirrer also contributes to rapid cooling. Stirring during the heating period also favours the distribution of heat and produces a perfectly uniform product. The coil provided for cooling allows not only rapid cooling but also pre-heating at a temperature corresponding to existing steam pressure if this is available. This ensures very economical heating; the consumption of electricity may be reduced, thus lowering costs, thanks to steam pre-heating. Frequently, however, the proportion of these expenses in the production costs of the product is somewhat over-rated. Working tests have shown that on the average the consumption of current per kilogram of finished resin product amounts to about 0.4 kW. Compared with the price of resin this is negligible. The operating costs of induction heating are reduced also by the fact that practically no repairs are needed; nor is trouble likely to occur which must be expected with other heating methods.

Induction heating is very simple to operate. Switch and control instruments are arranged compactly; they consist normally of an amperemeter for each coil, an automatic controller for checking the prescribed wall temperature, a two or multiple colour recording instrument, operating switches for coils and the contactor switches to connect controller or recorder with each coil. When a multiple recording instrument is used, additional control spots of the plant can be connected and recorded. The switchboard with contactor switches and fuses are fixed conveniently outside the production room, together with other switch apparatus.

Induction heating has proved its value, and it may be confidently concluded from the experience already gained, that this new form of heating will take a prominent place in the synthetic resin industry.

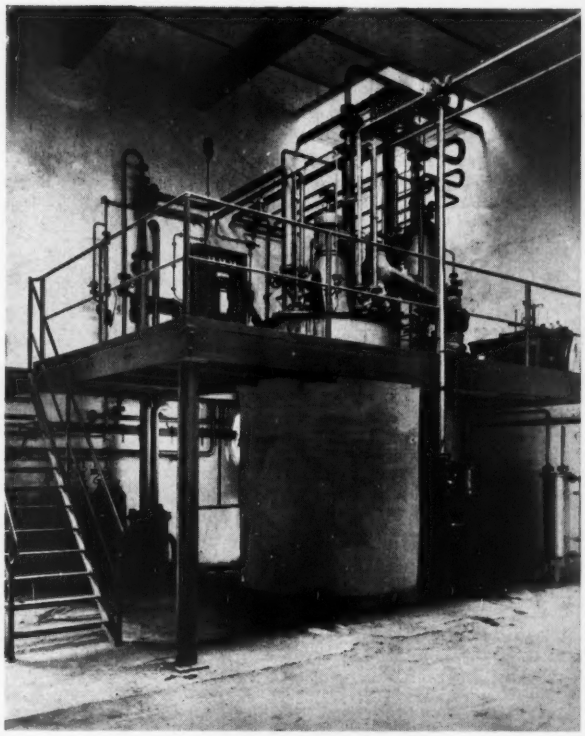


Fig. 4.—Plant of 3,000 kg. capacity.

New Productions

Soap-box and Brush

Three plastic materials have been used in combination to produce the latest addition to the range of " Poly-tainer " cosmetics containers. The fluted polythene box shown below is a container for soap. The nylon tufted nail brush, which is set in a polystyrene back, has been designed to fit the top of the box and thus to provide a lid. Due to the flexible nature of the container it is easy to remove the brush by squeezing the narrow ends of the container together. The soap-box and brush set is supplied by Industrial Appliances, Ltd., 21, Grosvenor Street, London, W.1.

Small Kitchen Containers

Some time ago Brookes and Adams, Ltd., 250-252, Barr Street, Hockley, Birmingham, introduced a range of large kitchen containers for rice, sugar, etc., moulded in coloured urea. These mouldings aroused great interest for their clean and useful design. A smaller range of kitchen containers has now been produced by this company in the same style. The containers are moulded in nine different colours from " Beetle " urea material. Fourteen transfers are available, and the manufacturers state that stockists will label to customers' requirements. A shelf holding four containers is also made in the same material.

Components for Portable Radio

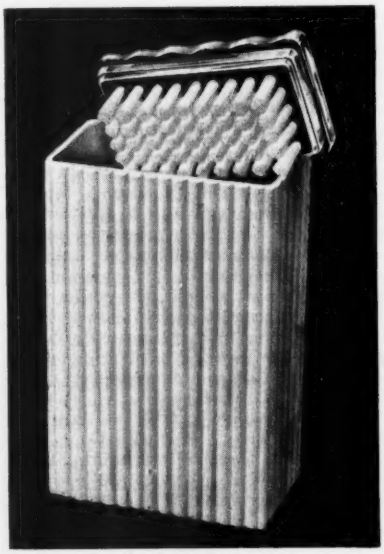
In the production of the Ferguson 351 portable radio a number of polystyrene components have been used and W. W. Ball and Sons, Ltd., Burstead Works, Kennel Lane, Billericay, Essex, have sent us some details of these parts for which they have made the tools and which they are moulding for Ferguson Radio Corporation, Ltd.

The wavelength scale is moulded in amber-tinted transparent polystyrene, using a two-impression tool on an eight ounce injection-moulding machine. The scale was designed for edge-lighting, two small bulbs illuminating the base which curves to the rear. Considerable moulding skill and accuracy is required to obtain sufficient clarity and freedom from weld-lines in the moulding, as well as a high degree of finish for the face and the lighting edge. To restrict illumination to the actual scale portion, the surround is decorated with a cross-diamond pattern moulded on the rear face of the scale. Medium wave and long wave scales and printed on the rear face by a hot foil transfer method.

Other components, including the handle and control knobs, were moulded in cream polystyrene. As may be seen from the illustrations, two of the controls have been combined by providing two concentric knobs, one fitting into the other.

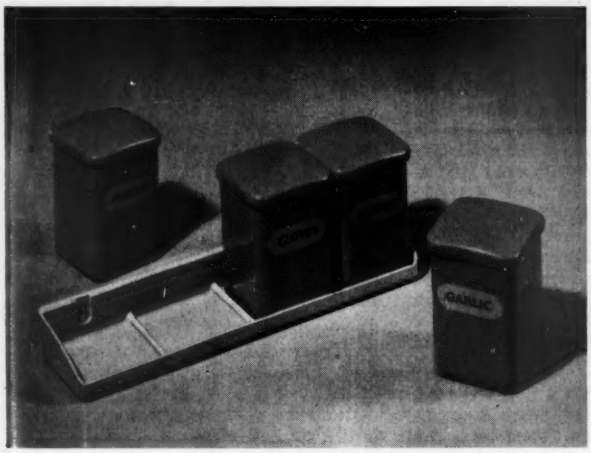
Tap Washers

A new type of washer for domestic water taps, injection-moulded in polythene, was described in " New Productions " recently (" Plastics," August 1952, p.237). We have received some further information about these washers from the manufacturers, Plastomatic Ltd. The polythene washer which is of hollow construction and includes an integrally moulded stem to give extra resilience, issued in combination with a brass shroud or annulus which is free to revolve around the stem of the washer. The brass shroud is designed to provide a " stop " when coming into contact with the top of the bibcock seating. In addition to taking up all wear following the final seating of the washer, the brass shroud allows for the expansion of the latter over the top of the bibcock seating.



Soap-box and brush.

Polystyrene components for the Ferguson 351 portable radio.

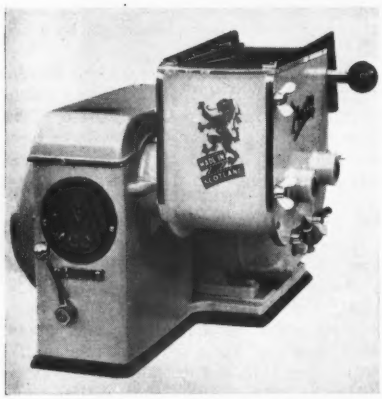


Small kitchen containers.

Ferguson 351 portable radio.

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes



NEW MIXER FOR LABORATORY WORK.—This Duplex Mixer has been designed primarily for laboratory work and for use in factories producing foodstuffs, chemicals, cosmetics, plastics, pigments and other substances. The advantages claimed for this machine are the substantial savings in time and materials. Tests can be carried out in the laboratory achieving the same conditions of mixing as those employed in actual factory production, without using a full-scale production machine with the relative increase in quantity of materials and without the disadvantage of withholding such a machine from the production line.

The mixing container is constructed of stainless steel and has stainless steel "Z"-type beaters running in self-lubricating bearings which ensure that no contamination can affect the mix due to oil or grease leaking through the bearings. The body of the container can be fitted with a steam jacket or a vacuum lid.

The Perspex lid which is fitted to enable the operator to keep the mix under visual observation also prevents any access to the beaters whilst they are in motion. The machine is operated by opening or closing this lid.

The drive is by means of a chain from the motor to a two-speed gearbox and thence by precision machine-cut gears to the beaters. Total capacity is seven pints with five pints working capacity. It has a ½ h.p. motor giving 940 r.p.m. Beater speeds: front, 63 and 126 r.p.m.; back, 100 and 200 r.p.m.

AN ELECTRONIC TEMPERATURE CONTROLLER.—In an increasing number of physical, chemical and biological laboratories, means are required for the precise measurement and control of temperatures, especially of water and oil baths. To meet such needs the Equipment Division of Mullard, Ltd., have recently made commercially available a Temperature Controller, type E.7594. This instrument enables the temperature of water baths and similar apparatus to be controlled to within fine limits, the response time being very rapid. The instrument has the additional advantages of being simple in operation, and compact and robust in construction. These features should make the instrument of particular value for use in connection with chemical analysis, and polarographic, conductivity, viscosity and refractive index measurements.

The overall dimensions of the instrument are as follows:—

Control Unit 6 ins. x 7 ins. x 6 ins.
Probe Unit 10 ins. x 1 in. x 1 in.

The weight of the equipment is 9 lb.

COPPER AND COPPER ALLOYS.—As from December 18, 1952, restriction in the use of copper, brass and other copper alloys has been removed under the Copper and Zinc Prohibited Uses (Board of Trade) (Revocation) Order, 1952, and The Copper and Zinc Prohibited Uses (Ministry of Supply) (No. 5) (Revocation) Order, 1952.

DIBUTYL PHTHALATE.—British Industrial Solvents, Ltd., announce the reduction in the price of dibutyl phthalate by 2¼d. per lb. The new schedule of prices is as follows: 10 tons spot or contract over six months, 2s. 3d. per lb.; 1 ton spot or contract over six months, 2s. 3¾d. per lb.

"BISOL" ACETATES REDUCED.—British Industrial Solvents, Ltd., announce reductions in the prices of "Bisol" butyl acetate and ethyl acetate, that took effect on all dispatches made on and after Monday, December 15, 1952.

The following is the new schedule of prices:—

	Butyl Acetate	Ethyl Acetate
20 tons spot or contract ...	£191 per ton.	£151 per ton.
2 tons spot or contract ...	£193 per ton.	£153 per ton.

ACETIC ACID.—A. Boake, Roberts and Co., Ltd., announce that, with effect from December 1, the price of the above material is decreased as follows: Glacial Grades by £12, 80 per cent. Grades by £10 per ton.

SOLUBLE NYLON.—I.C.I. are now producing, in development quantities, a polymer known as "Nylon Soluble Polymer Type CA," which is soluble in alcohol/water mixtures. From these solutions, films and coatings can be produced which have good temperature and abrasion resistance, are tough and very permeable to water vapour. These properties fit the films for varied uses as adhesives, and as coatings for monofilaments and for textiles. The polymer has also an important part to play as a textile finishing agent, a grade known as "Calaton CA" having been developed for this purpose. These polymers, chemically different from those used in the production of textile fibres and monofilaments, have been available in America for some time, and a number of interesting applications have been developed.

SOCIETY OF PLASTICS ENGINEERS.—Amongst the papers to be read at the Ninth Annual Technical Conference on January 21-23, at Boston are: Professional Training for the Plastics Industry, Glass Bonded Mica, Epoxy Casting Resins, Plating and Lacquering Plastics, Mould Design and Standardization and Techniques of Injection and Compression Moulding Polytrifluroethylene.

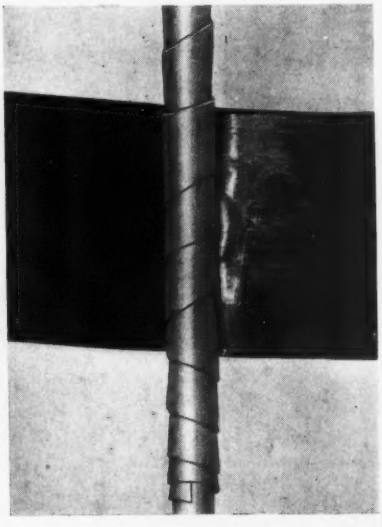
AERO RESEARCH, LTD.—We have received two bulletins in the series Aero Research Technical Notes. No. 113 deals with the glueing of "Stramit" boards with the aid of "Aerolite" CB, in continuous production. No. 119, entitled "Accelerated Glue-line Curing" details the use of Electrothermal Rubber Sheeting with "Aerolite" K and KL.

PECO PRODUCTS.—We have received an interesting little publication dealing with the plastics machinery division of the Projectile and Engineering Co., Ltd. Containing an introduction by Mr. M. Freund the booklet shows, with the aid of well-captioned photographs, the production and testing of Peco machines, installations in the works of customers, mould manufacture and mouldings.

SELF BONDING INSULATING TAPE.—Telcohesive, manufactured by the Telegraph Construction and Maintenance Co., Ltd., Greenwich, S.E.10, was originally designed for submarine cable joints, and is now marketed in 1-in. reels of 10-yard length.

Translucent and extensible, Telcohesive is wrapped round materials to be joined, slightly over-lapping at each turn as will be seen from the illustration. Water-tight joints are possible for cable insulation, between lead and thermoplastic sheathed cables and high-voltage power cable joints for exterior work. The manufacturers advise backing it with another tape resistant to abrasion, cutting and ultra-violet light. Properties given by the manufacturers are as follows: soluble in hydrocarbon and chlorinated solvents. Unaffected by water, diluted acids, alkalis or salts in solution.

Power Factor at 1 Mc/s ...	9×10^{-4}
Permittivity at 1 Mc/s ...	2.3
Resistivity	10^{17} cm.



"Telcohesive" self-bonding insulating tape (Telegraph Construction and Maintenance Co., Ltd.)

POLYTHENE FILM IN THE U.K.—Imperial Chemical Industries, Ltd., and the Visking Corporation of Chicago U.S.A. are proposing to form a joint company in Great Britain to manufacture polythene film. The Visking Corporation was formed in 1925 to manufacture seamless transparent tubes from regenerated cellulose, a product which has since found world-wide use for sausage casings. The fundamental research work of the Visking company into extrusion processes has, in recent years, enabled it to develop a range of products based on the modern thermoplastics.

At the request of the U.S. Government during World War II the Visking Corporation developed a process for manufacturing unsupported packaging film from polythene. Subsequently, they have developed a large market for this product which is sold under the trade name of "Visqueen" and to-day Visking are the world's largest producers of polythene film. Polythene which was discovered in I.C.I. laboratories in 1933, is sold by I.C.I. under the trade name "Alkathene." I.C.I. also pioneered its manufacture in film form in Great Britain. The proposed joint company will combine the resources of I.C.I. with those of the Visking Corporation, who have unique experience and knowledge of the production of the high-quality polythene film required to meet the ever-increasing demands for defence purposes and industry generally. Polythene film is transparent, tough, inert, moisture- and water-proof, and is used for a diversity of protective packaging applications. Bags, wrappings, and drum and case liners are used in packing foodstuffs, pharmaceuticals, chemicals, electrical and metal components of all sizes, textiles, silverware, machinery, etc.

Its chemical inertness and moisture-resistance prevent corrosion and enable it to be used in contact with moisture-sensitive and reactive chemicals. Its use for frozen foods and high-altitude meteorological balloons indicate its unique resistance to cracking at low temperatures. Its electrical properties enable it to be used for lapping cables. The protective merit of polythene film has found favour in defence programmes and export packaging where long storage and "tropicalization" are required.

CRYSTIC RESIN SERIES.—Scott Bader and Co., Ltd. announce a new series of resins to supplement their Marco range. The new series is sold under the name of Crystic, and each product is designed to meet the specific requirements of a particular application. The first product is supplied at the following prices:—

	per lb.
Ton lots	4s. 3d.
10-cwt. lots	4s. 4d.
1-cwt. lots	4s. 5d.
10-100-lb. lots	4s. 6d.

Free delivered, including packing—usual terms.

The manufacturers state that Crystic 185 is designed specifically for low-pressure laminated mouldings, particularly where glass-cloth or chopped-glass strand mat are used. Its low price makes it especially attractive for large products such as boat hulls, car bodies, aeroplane parts, laundry tubs, baby carriages, corrugated roofing lights, ducting, etc. Crystic 185 is also particularly suited for the large-scale moulding of articles using the preformed mat technique. It is not so suitable as Marco Resin SB.28C for electrical applications. but for many domestic applications where there is a need for a special hot or cold setting polyester of low price, Crystic 185 will be found highly satisfactory.

Photographed at a cocktail party given by the chairman and directors of Ranton and Co. Ltd., at 23 Knightsbridge, December 11: from left to right, Peter Brown and E. Westnedge, of British Resin Products, Ltd. and A. S. Welch of James Ferguson and Sons, Ltd.

SCOTT BADER AND CO., LTD., announce the appointment of Mr. John Hand, B.Sc., as Technical Director as from January 1, 1953.

Mr. Hand is well known in the Paint, Printing Ink and Rubber trades as an authority in technical matters, particularly the fields in which synthetic resins play an important role.

"CELLOBOARD" FACTORY.—It has been announced that Gaby Schreiber and Associates have been commissioned by Vere Engineering Co., Ltd., to do the architectural and design work for their "Celloboard" factory which is to be opened near Colchester in February, 1953. New buildings for administration, gatehouses, car parks, laboratories and canteens are being designed, and the consultancy service covers colour schemes and lighting for the existing factory building and for plant and machinery.

MR. L. G. CHAFFEY.—We regret to announce the tragic death of Mr. L. G. Chaffey, General Works Manager of Insulators, Ltd., who died suddenly from a heart attack in the early hours of Thursday, December 18, 1952.

Though he was very early associated with the plastics industry, he was, as a youth, apprenticed to Moss Gears, Ltd., in the engineering industry. His first association with plastics was with Moulded Products, Ltd., in Birmingham, and he worked with Mr. H. W. Ireland. He next went south to Solidite, Ltd., and then to Viscose Development, Ltd.

His main association was perhaps with Messrs. Kent Mouldings, of Sidcup, for whom he put in very great efforts during the war period.

He joined Insulators, Ltd., just over six years ago, and Mr. W. C. Waghorne writes: "I would like to place on record that I have never worked with a more loyal or energetic colleague. He always entered wholeheartedly into any venture he undertook and, apart from his pressing business duties, found time and effort to give to the technical side of the industry in its broader aspects."

The industry has suffered a loss which it can ill afford.

REINFORCED PLASTICS TECHNICAL COMMITTEE.—The Council of the British Plastics Federation, at its last meeting, approved terms of reference of a special technical committee to deal with reinforced plastics. It will be known as "The Glass and Asbestos Fibre Reinforced Plastics Technical Committee." The first meeting will be held at the Federation offices, 47-48, Piccadilly, London, W.1, on Thursday, January 15. Membership of the Committee is restricted to members of the Federation.

ELECTRICAL ENGINEERS EXHIBITION, EARLS COURT, 1953.—The Second Electrical Engineers Exhibition organized by The Association of Supervising Electrical Engineers, 54, Station Road, New Barnet, Herts, is to be held at Earls Court, London, S.W.5, from March 25 to 28.

ECUADOR, INQUIRY FOR VARIOUS GOODS.—The British Embassy at Quito has reported that the Union Comercial Industrial C.A. of P.O. Box 2818, Quito, wish to make contact with United Kingdom manufacturers of the following goods:—Transparent cellulose film; Plastic upholstery material.

MERRIGLO, LTD.—The name of this company has been changed to Campden Plastic Products, Ltd.

MONSANTO CHEMICALS, LTD.—After Monday, January 5, all departments of the Sales Division will be housed at Victoria Station House, Victoria Street, London, S.W.1, telephone Victoria 2255.

PRITCHETT AND GOLD AND E.P.S. CO., LTD., the battery makers, of Dagenham Dock, Essex, have moved their offices to 137, Victoria Street, London, S.W.1. The telephone number and telegraphic address are TATe Gallery 9212 and Storage, Sowest, London, respectively.

LUMB HALL ENGINEERING CO., LTD., announce that the engineering section of the above company has been acquired by John Prior, A.M.I.Mech.E., F.P.I., who will continue to trade at the above address as John Prior Engineering Co. (Later as John Prior Engineering, Ltd.)

BRITISH MOULDED PLASTICS LTD., have transferred the administration and sales organization from 37, Portman Square, London, W.1, to Avenue Works, Walthamstow Avenue, London, E.4, and all communications should be sent to the Avenue Works address.

BOROUGH POLYTECHNIC.—A special course of six lectures on recent advances in compression, injection and extrusion machinery will be given weekly by specialist lecturers, beginning on Tuesday, January 27, 1953. The course has been organized with the co-operation of the Plastics Institute. The fee is one guinea and further particulars may be obtained from the Secretary of the Polytechnic.

NEW BOARD OF DIRECTORS FOR R. H. WINDSOR, LTD.—To broaden the basis of the company R. H. Windsor, Ltd., announce that a new board of directors has been appointed. Mr. R. E. G. Windsor, son of the late R. H. Windsor who founded the business, remains managing director. His chairman is Mr. Arthur George Dennis, LL.M. Two other new members of the board are Mr. Henry Vincent Yorke and Mr. C. Norman Baker, F.C.A.

INSULATORS, LTD.—Mr. L. Coltman has joined Insulators as Northern representative. He was previously with the Bushing Co., Ltd.

BRITISH MOULDED PLASTICS inform us that they have entered into an agreement with Prodorite, Ltd., Eagle Works, Wednesbury, Staffs, to make rigid tubing and fittings from plastic materials for chemical engineering installations, the goods so made to be distributed by Prodorite, Ltd. There will be collaboration between the sales organizations of the two companies and a complete exchange of technical information.

PACKAGING EXHIBITION.—The third National Packaging Exhibition will be held at Olympia from January 20 to 30. Featuring machines, materials and techniques of the British packaging industry, the exhibition will also include examples of some of the latest Continental and American equipment. A number of important new developments will be on show, and these will include the use of several types of plastics materials.

THE GAUGE AND TOOL-MAKERS' ASSOCIATION has now completed preparation of a document entitled "A General Guide in Compiling a Syllabus of Training for Apprentice Toolmakers," with the object of assisting gauge- and tool-making firms in the introduction and operation of apprenticeship schemes.

The Syllabus covers stores and servicing, lathes, milling, shaping, grinding, drilling and tapping, jig boring, heat treatment and laboratory practice, progress and inspection, bench, machine maintenance, drawing office, etc.

Copies of this Guide, which is now being printed, will be available early in the New Year, price 5s. post free, on application to the Offices of the Association at Standbrook House, Old Bond St., London, W.1.

MODERN PACKAGING ENCYCLOPÆDIA, 1953.—Published by the Packaging Catalog Corporation, 575 Madison Avenue, New York 22, contains a wealth of facts and figures. It is well indexed and the trade information will be valuable to any organization connected with American markets.

ANNUAL HANDBOOK OF PRODUCT DESIGN FOR 1953.—Published annually as part of the subscription to Product Engineering, McGraw-Hill Road, 95, Farringdon Street, London, E.C.4.

VINYL PRODUCTS, LTD., announce that their telephone number has been changed to Wallington 9282.

CLARITUDE, LTD., announce that their address is now 35a, Hertford Street, London, W.1. Telephone, Grosvenor 3981.

DR. N. A. DE BRUYNE.—The importance of synthetic resin adhesives to modern aircraft construction is emphasized by the visit to U.S.A. of Dr. N. A. de Bruyne, managing director, Aero Research, Ltd., Duxford. By arrangement with Ciba, Ltd., New York, an associate company, he is at present delivering a series of lectures to

designers and production engineers and visiting executives of leading American aircraft companies. His subject is "Redux," the metal-to-metal bonding process used extensively in the "Comet" air liner. No comparable process is available in U.S.A.

BRITISH PLASTICS EXHIBITION—CHANGE OF DATE.—The opening of the second British Plastics Exhibition and Convention, at Olympia, London, originally fixed for Wednesday, June 3, 1953, the day after the Coronation, has been postponed until Monday, June 8, 1953. The Exhibition will close on Thursday, June 18, instead of on Saturday, June 13. Hours of opening will be 10 a.m. to 6 p.m., and the price of admission 2s. 6d.

The original dates were fixed by the organizers before the date of the Coronation was known. They have been changed, at the suggestion of the British Plastics Federation, because of difficulties foreseen in completing the Exhibition on time owing to the public holiday on June 2.

The organizers ("British Plastics," Associated Iliffe Press, Dorset House, Stamford Street, London, S.E.1.) state that all space on the first floor of the Exhibition has been taken and only a very few sites on the ground floor remain vacant.

DR. C. A. THOMAS, President of Monsanto Chemical Co., St. Louis, U.S.A., and Chairman of the American Chemical Society, has been awarded the Perkin Medal for 1953. Dr. Thomas is distinguished in the field of atomic energy and the synthesis of the resins from petroleum and its by-products. The medal was founded in 1906, the first recipient being Sir William Perkin, who prepared the first synthetic dye.

FORTHCOMING MEETINGS

Jan. 16.—"Control Equipment Devices," G. T. Collins, Plastics Institute, Midlands Section. James Watt Memorial Institute, Great Charles Street, Birmingham, 3, 6.30 p.m.

Jan. 21.—"The Electrical Properties of Plastics," T. Halse, B.A., A.M.I.E.E., Plastics Institute, Western Section. The Technical College, Stroud, 7.0 p.m.

Jan. 21.—"Aminoplastics," C. P. Vale, M.A., A.R.I.C., A.P.I., Plastics Institute, Scottish Section. Institution of Engineers and Shipbuilders in Scotland, Glasgow, 7.30 p.m.

Jan. 21.—"Organizing for Profit," J. B. W. Toole, Plastics Institute, Southern Section, with Institution of the Rubber Industry. Polygon Hotel, Southampton.

Jan. 23.—"Designing Plastic Products," A. H. Woodfull, M.S.I.A., Plastics Institute, North-Western Section. Engineers Club, Albert Square, Manchester, 6.45 p.m.

Jan. 30.—Annual Dinner-Dance, Plastics Institute, North-western Section. The Grand Hotel, Manchester.

Jan. 28.—"New Synthetic Fibres," Dr. B. P. Ridge, B.Sc., Ph.D., F.R.I.C., F.T.I., Plastics Institute, North-Eastern Section, with Royal Institute of Chemistry. Kings College, Newcastle.

Jan. 31.—"The Treatment of Waste Gases in Chemical Industry," W. A. Damon, Institution of Chemical Engineers, Midlands Branch. The University, Edmund Street, Birmingham.

Feb. 2.—"The New Wool-like Fibres," Dr. D. Trail, Society of Chemical Industry, Plastics and Polymer Group, with London Section. Burlington House, Piccadilly, London, W.1, 6.30 p.m.

Feb. 9.—"Some Problems Involved in the Colouring of Plastics," C. H. Hall, Plastics Institute, London Section. Waldorf Hotel, Aldwych, London, W.C.2, 6.30 p.m.

Feb. 11.—"What Shape for Thermosets": "Product Design," A. H. Woodfull, M.S.I.A.; "Mould Design," James Butler, A.M.I.Mech.E., A.M.I.B.F., F.P.I., Plastics Institute, South Wales and Monmouthshire Section. Cardiff Technical College, 7.0 p.m.

TECHNICAL PUBLICATIONS

The following books are obtainable from booksellers or from the publishers, Temple Press Ltd., Bowling Green Lane, London, E.C.1.

"Plastics Scientific and Technological"—3rd Edition. By H. R. Fleck, M.Sc., F.R.I.C. The standard textbook on the chemistry and technology of plastics. 40s. net or 40s. 9d. post free.

"Cellulose Acetate Plastics." By Vivian Stannett. Comprehensive technical survey for the engineer and chemist. 30s. net or 30s. 9d. post free.

"Moulds for Plastics." By W. M. Halliday. Mould designing, construction, operation and maintenance. 30s. net or 30s. 6d. post free.

"The Theory of Polymerization." By H. R. Fleck, M.Sc., F.R.I.C. A book for students, with laboratory exercises and calculations. 10s. 6d. net or 11s. post free.

Faults and Irregularities in Injection Mouldings—II

By W. M. HALLIDAY

Having discussed faults and errors affecting the dimensional accuracy and shapes of mouldings, the author goes on to discuss defects affecting surface finish and appearance, and irregularities affecting the physical properties of components.

Surface Irregularities

THE six common surface defects, listed in the first portion of this article, are:—

Flashings, and their removal scars.
Surface-flow markings. Waviness.
Dull surface patches.
Bubbles and blisters.
Surface sinks and depressions.
Staining, pitting and corrosion.

Some of these faults may be considered together because, in certain cases, the same cause or causes will be found to underlie several of these irregularities.

(d) **Flashings**

With a correctly designed and accurately constructed mould flashing should be maintained at a minimum. Nevertheless, certain minor defects of this nature might be unavoidable.

The most usual locations where flashing occurs are: At the main parting surfaces in the mould; around air-venting channels located across those surfaces; at the gate; around ejector-rod contact points; at core-plug joints or bearings where these intersect the wall of the cavity.

With a sound mould design it is nearly always possible to keep flashings arising from any of the above sources to a minimum, or to locate such points so that resulting flash can be removed without leaving an objectionable scar.

In practice, it is found that tendencies towards flashing increase as the mould is continued in production use. Certain points and surfaces in the tool will suffer some wear, or even slight damage, resulting in thickened flashings on the sides of the component. The ways and means to be adopted for overcoming troubles of this kind are again quite plain and well understood by mould engineers.

One important point deserves to be noted, however. Very often flashings may be a source of trouble when ejecting the article, due to the tendency of the component to hang or stick in the cavity. This will particularly arise in connection with the ejector rods employed in the mould. If the contact ends of such rods have become worn or slightly damaged, this will produce a collar flash ring on the surface of the part. If the mouth of the ejector-rod bearing hole has worn bell-mouthed, as often happens, material will be forced into the interstices, and the component will hang upon such flashing instead of being smoothly ejected. A sticking moulding of this kind may require additional ejection pressures, whilst thin and slender wall portions may be seriously distorted or cracked as a result. Moreover, since ejector rods will usually be disposed so as to bear against some internal surface of the article, considerable difficulties may be entailed in removing such collar flash without leaving a very unsightly scar.

The same effects may also occur in respect of movable core plugs and their bearing holes in the mould block.

(e) **Surface flow markings**

These are very common and familiar surface defects, and whilst not very serious as regards the strength and durability of the component, they may mar the good, smooth appearance of the moulding. These irregularities will show as a mass of fine lines, or striations, on the surface of the component. Sometimes they appear to have a definite form or pattern, hence the common designation of "flowers." These markings will be of minute depth, i.e., rarely more than one or two ten-thousandths of an inch, and they constitute no physical weakening of the moulded article.

Several causes may give rise to this condition; a few of the more usual ones may be mentioned here, viz.:—

Incorrect mould temperature. If certain critical portions of the mould are operated at too low a temperature part of the flowing charge admitted to the cavity may set too rapidly. This, in its turn, will grossly arrest or divert the main flow to other parts of the cavity formation. Undesirable turbulence may also ensue, still further increasing the tendency to produce flow markings. The correction of this condition usually comprises taking steps to ensure more uniform and stable heat throughout the mould. This may be easily accomplished by closer adjustment of water cooling on the tool, or by taking a few successive shots and allowing a longer interval to elapse before ejecting each component. This will increase the heat of the mould automatically.

Restricted gate entry. As already explained in connection with another irregularity, the gate may be too small in capacity to allow a free and copious flow into the cavity. The slow rate of filling means that thin wall sections of the component will chill and set quickly, arresting flow to the thicker portions.

Uneven wall thickness in the component. If the component has to be moulded with unduly thick portions located far from the gate, flow may be impeded in the cavity to a degree which will cause premature setting at certain points. The resultant flow to the remoter portions of the cavity will become sluggish and flow markings are more liable to occur on those sections of the component. This trouble may be overcome by several expedients. For instance, ribs or beadings may be incorporated in the walls of the component to bridge the thin and thick sections. The channels formed in the cavity walls for such ribs will then also materially assist in redirecting and improving the flow to all portions of the cavity.

The mould temperature may be increased especially surrounding the affected spots or, alternatively, the heat of the material may be raised to ensure an easier flow.

Sometimes, increasing the injecting pressure will be extremely useful, especially in conjunction with the adaptations to mould and material temperatures. This will give a quicker fill of the cavity and so reduce the disparity of setting time between thin and thick portions of the component. Some assistance may also be derived by removing the finished moulding from the cavity at a quicker speed immediately after the injection stroke.

Low temperature of material. If this should occur, the material injected into the mould may be too close to its setting temperature and, in fact, may even have partially set into small lumps. This will, of course, greatly retard the rate of fill of the cavity, allowing premature setting to take place at specific points and more sluggish flow to other parts of the area, again producing flow markings.

The corrective treatment required is to increase the temperature of the material in the injecting chamber; this should be done gradually—a few degrees each shot, extending over a few runs. Coincident with this step, the gate may usefully be extended or deepened slightly until mouldings are formed free from flow markings, whereupon the material temperature should be stabilized.

The elimination of flow markings will embrace all steps taken to increase the rate of fill, to prevent premature setting, and to avoid turbulence of flow in the cavity.

(f) **Dull patches, bubbles, and blisters**

Dull patches on the surface of the component may be caused by insufficiently high lustre on the cavity walls in the mould.

This will arise most often with moulds which are not chromium plated, and where a high polish has to be provided directly onto the basic steel surfaces. Dull patching may also occur as a result of a fine scale left on the steel surfaces of the mould by hardening treatment, or by chemical action from overheated material.

If certain portions of the mould are allowed to become excessively hot, or if the plastic charge is grossly overheated, the outer layers of the charge impinging first against the hot walls of the cavity may become slightly burned, and will leave a hard, dull deposit on the walls. This is difficult to remove, especially where the tool is not plated, and all later components will have a corresponding dull patch.

Bubbles and blisters usually develop from using the material at too high a temperature, although they may sometimes be caused by trapped air pockets in the cavity, or internal sponginess and porosity. This will be explained when dealing with the causes of physical defects in mouldings.

(h) **Surface sinks and depressions**

These faults, often most troublesome to isolate and correct, are closely inter-related with the design of the component. For

instance, they frequently occur because of unequalized shrinkage in a moulding having very uneven wall thickness, or heavy bossed-up portions.

Usually the surface sinks occur on thin-walled sections immediately abutting thick sections.

It has already been explained how, with components having very unequal wall thickness, etc., the thin portions will tend to set first, and material will be drawn from these portions by the later cooling of the heavy portions. This will usually be safely accomplished providing the disparity between the respective setting points is not too great, and when the inner layers of the thin sections have not been completely set. With these conditions, the contraction of the later-cooling heavy masses will be satisfied without producing distortion to the component.

With the considerable pressures arising by the contracting material, the internal structure of the partially set thin sections may be formed with small voids. These, in turn, will create considerable suction pressure upon the rigid outer layers of the material, so that these layers will tend to be drawn inwards in an endeavour to compensate for the voids, thus forming a slight sinking or depression on the external surface. Sometimes this will be concentrated into one well-defined spot, or there may be several shallow sinks distributed over a fairly wide area. The same condition is sometimes caused by cold spots in the mould cavity.

Much can be accomplished to obviate this condition by close attention to the design forms of the component and mould by providing ribs and fillets at the junction of thick and thin walls, to arrest the shrinkage forces set up in the cavity.

Frequently an effective solution will be to alter the position of the gate entry into the cavity to ensure that the thin wall portions will be fed appreciably later than the thick sections, thereby equalizing flow and the later shrinkage influences.

Increasing the heat of the mould at specific points, i.e., those portions adjacent to cavity formation reproducing the thinner sections, etc., may again be of some help.

(i) Staining, pitting and corrosion

Sometimes the moulded component may be disfigured by the presence of discoloured patches, which will be plainly discernible when the component is cooled off to room temperature. These arise from what is known as *stained cavity surfaces.*

This condition may be caused by several factors, such as contaminated or excessively damp material, overheated material, or too high mould temperature.

The fundamental cause is often very difficult to track down, especially if contaminated material is suspected. It sometimes is found associated with use of material which has been stored for a long period, especially if it has been allowed to become exceedingly damp. Possibly long storage, coupled with prolonged dampness, causes some deterioration in the colouring pigments embodied in the powder which, upon heating, react in an unusual manner and release certain colouring ingredients, which are then deposited upon the surface of the mould in the form of a tenacious film. This, in turn, is transmitted to succeeding articles produced from the mould, which will all possess a dull discoloured patch coincident with the cavity marking. The correction of this condition will, of course, consist of checking the material, and ensuring that it is perfectly dry.

Staining of the mould and components may also arise from burning of the material in the mould due to excessive material and tool temperatures. Under such conditions, the outer layers of the injected charge most intimately coming into contact with cavity surfaces may be burnt slightly, and from this chemical action certain colouring ingredients may be released and deposited upon the cavity walls to form a stained patch. This will usually be associated with specific qualities and colour ranges of thermoplastic materials. Such discoloration on the mould should be immediately removed by polishing, and the temperature of the injecting chamber and material lowered. At the same time, steps should be taken to reduce the heat of the mould at the affected points. Correction of this trouble may entail a good deal of time since various adjustments may be required.

Pitting and corrosion. These conditions usually emanate from deterioration of the polish or plated surfaces in the mould cavity, and generally develop after the mould has been in use for a lengthy period. Pitting and corroding of the cavity is often caused by unsatisfactory storage conditions for the tool between production runs.

For instance, if the mould is placed into the store without first being scrupulously cleaned and examined on the critical cavity surfaces and thereafter coated with an anti-corrosion compound, the slight moisture, dirt, particles of moulding material, etc., left in those areas may cause serious corrosion and pitting. These defects will be reproduced on the moulded components when next the tool is placed into production.

A mould condition of this character is serious because it might entail a considerable amount of costly repolishing, or in hard, chromium-plated cavities breaking of the plating surface may cause peeling of the plating metal when the mould is next used, and the only course open would then be to replate the whole mould.

Corrosion and pitting may also develop during use of the mould, due to use of damp or contaminated material, the accidental ingress of moisture into the cavities, or to the generation of corrosive gases in the cavity at the instant of injection.

The means to be adopted for the avoidance and elimination of these troubles will be apparent from their origin and development.

Summing-up the aforementioned causes of surface defects and irregularities, the following general points will be found of some guidance. The principal reason why injection-moulded components possess high lustre, smoothness, with clean, sharply defined detail configuration, etc., is that they are formed by the plastics material charge—in a fluid or near-fluid condition—being powerfully pressed into intimate contact with the surfaces of the steel-mould cavity configurations, thus faithfully reproducing the shape, size and quality of surface finish of those cavity walls, cores, etc.

Moreover, the injecting pressure will be maintained on the flowing material charge within the cavity for a sufficiently long interval to permit cooling and setting to take place. This occurs very rapidly, i.e., usually a dwell of only a few seconds being required to effect such solidification, whereupon the component may be safely ejected.

With certain thermoplastic materials the component may have to be ejected before complete rigidity has been obtained, but even with these the "set" will have to be sufficiently advanced to ensure that the part can be removed without risk of distorting the shape. It follows that any of the following factors or influences obtruding into such a moulding process will diminish the quality of finish or accuracy of the article.

I.e., when the effect of any such condition is:—

(a) To impair or diminish the high polish, smoothness or uniformity of shape of the cavity walls.

(b) To create a film or any similar condition between the surfaces of the cavity and the incoming material charge, so preventing the latter from making the necessary intimate contact.

(c) Any influence which tends to cause premature cooling and setting of the charge, or portions thereof, before it has been brought wholly into contact with the cavity surfaces.

(d) Any condition which reduces the injecting pressure.

(e) Any factor whose effect is to reduce the velocity of the flow to, or within, the cavity; and finally

(f) Any condition present in the cavity formation which will create excessive turbulence of the flowing material, or serious deflection from its proper direction to all parts of the cavity.

Bearing in mind these six important considerations, it will be much simpler to conduct any orderly examination of the mould or moulding conditions when diagnosing the causes of surface irregularities and defects. Such an analysis will simplify the task of determining and applying requisite corrective treatments.

Irregularities Affecting the Physical Condition of Component

The last three component faults listed in the preceding article ("Plastics," December, 1952, p. 370), viz., cracking, porosity and uneven shrinkage effects, are the irregularities which usually will be the most serious in their effects, and often the most difficult to correct.

Each condition will affect the physical strength and structural quality of a moulded component by introducing sources of weaknesses and surface-finish deficiencies. Very often they are accompanied by certain secondary faults, which may impair the precision accuracy or quality of surface finish.

(j) Cracking

Design or construction deficiencies in the mould, unsatisfactory working conditions surrounding its use, or unsuitable forms and features in the component design may, individually or in combination, cause cracking of the component.

The condition usually arises in one of

two forms. There may be a single large crack, extensive in length and penetrating deeply into the wall of the component, or there may be a mass of very fine, hairlike surface cracks extending over a considerable area. Both kinds will have serious effects on the strength, serviceability and appearance of the component.

Examination, by magnification, of the second form of cracking will reveal that each hairlike crack forms a distinct break in the outer skin of the component wall, but the depth may be shallow. It is not to be assumed, however, from this relatively shallow depth that the weakness of the wall will not be diminished, because below the crack the structure of the material may be crystalline in character, and so weak throughout the affected area.

Some of the more common causes of cracking and corrective treatment to be applied for overcoming the condition are listed below.

1. *Shrinkage.* Cracking of the wall structure of a component may be caused by unequalized shrinkage and resultant contraction stresses between various sections of uneven wall thickness. For the reasons already noted in the first article (December, 1952), when heavy portions of the wall are joined to thin sections the latter will "set" at a much quicker rate, this often resulting in those portions being distorted out of true shape by the natural greater contraction of the adjoining thick masses of material. The pressures created by the contraction of different wall sections can produce cracking of the thin walls, especially if these are restrained from contraction by the interposition of fixed core plugs, ledges, or similar stationary mould elements.

The above conditions will be connected with the design of the component and mould and may be remedied by, for example, the introduction of strengthening ribs and fillets at weak locations, or alternatively, reducing the disparity in wall thickness throughout the part, or providing a greater amount of ejection taper on the sides of all cores and cavity walls which otherwise would restrict the movement of these portions when subjected to normal contraction.

2. *Taper of cores, etc.* Cracking may sometimes be caused solely because important cores or other fixed portions of the mould cavity are not provided with a sufficient amount of taper or "draft" on their side surfaces; or because these portions of the cores, etc., may be badly polished, slightly scored or rough. Unless sufficient allowance is provided on all such critical elements interjecting into the cavity, and around which the walls of the moulded component are to be formed, increased injection pressures may be required.

One of the most common results of such lack of "draft" is that the moulding will be immediately misaligned on its core when the ejector rods are actuated and pressure is transmitted to the component. When this arises, instead of the component being pushed off the cores in a smooth and truly axial manner, binding and sticking will take place. Such binding action may produce severe distortion, and even cracking, of slender walls or other relatively unsupported portions.

Elimination of these and kindred troubles is again a matter of mould design and construction. In designing cored holes in the component close attention should be paid to the permissible taper to be allowed on the core plug. This should never be less than 2 degrees, except where the depth of hole is less than the diameter of the hole. The greater the amount of taper, the easier and safer will be the ejection process, and consequently the risks of distortion, warping or cracking of the article.

A smooth polish and even surface should be provided on all core plugs and cavity formations from which the component is to be stripped, to reduce frictional resistance and binding tendencies. Tooling markings, scratches, nicks and burrs should be scrupulously avoided.

3. *Ejector rods.* The actual ejection operation may sometimes give rise to distortion and cracking. This will chiefly occur if the ejector rods are incorrectly disposed relative to cores, and to the thick and thin portions of the component. They should be situated to bear on those portions where the greatest resistance to strippage is likely to develop.

All ejector rods impinging into the cavity area should be set to bear uniformly on the sides of the component, to give an even axial push to all portions when stripping it from cores.

If the ejector rods are inaccurately mounted to the sliding ejector rail, or if the latter element is inaccurately guided, the whole mechanism may be caused to move in a misaligned direction, causing some or all of the rods to bind in their guide holes, retarding their forward movement and causing uneven distribution of the ejection pressure over the critical areas of the article. The moulding would thus be twisted on the cores, excessive bind would arise, and slender or unsupported wall portions may suffer distortion or cracking. The corrective treatment necessary will be self-evident.

4. *Speed of ejection.* A fourth cause of cracking may be the over-quick ejection of the component from the mould. A certain interval must be allowed before the mould is opened and the article stripped from its cores, so that the necessary "set" will have taken place.

With a moulding of greatly varying wall thickness, this dwell period between injection and ejection will be the time necessary for the thickest portions to have set sufficiently rigid to be capable of withstanding the stresses imposed by the ejector rods. To limit the length of this dwell is yet another reason why uniform wall thickness should be attained.

5. *Moulding temperature.* Cracking or serious distortion may arise if the mould and material temperatures are excessively high. Such overheating delays still further the critical "set" times, and if ejection is carried out according to a normal estimated time, and before the component has become properly solidified, warping and cracking may be caused.

This trouble is eliminated by reducing gradually mould and material temperatures.

6. *Cold spots.* Minute hair-like surface cracks may sometimes develop as a result of excessively cold spots in the mould cavity walls. When material is injected into the cavity, that portion impinging against such cold spots will be chilled too rapidly and severe localized contraction will occur. This will have a very unequalized effect upon the general volumetric shrinkage and serious internal stresses may be created which, in turn, cause cracks on the surface of the part. Closer stabilization of the mould heat, and probably some adjustment to the water-cooling facilities, will correct this condition. If a few shots are taken at a rather quicker speed than normal production rates, the cool portions of the mould may readily be brought to the required working temperature.

Such cool spots will tend to persist if the walls of the mould immediately behind some portion of the cavity are left unduly thin, as sometimes happens when deep cavity formations have to be provided. This will allow a much quicker radiation of mould heat from those points than from adjacent thicker portions of the tool.

This condition can be avoided when the cavity layout is designed.

7. *Trapped air and gases.* Cracking may also occur because of the inadvertent trapping of small pockets of air, gas or generated fume in portions of the cavity. Such air pockets will form voids in the internal structure of the component, and as a result suction pressure will develop. This will be concentrated upon the unduly thin shell of material surrounding the void spot, possibly giving rise to slight bubbles or raised spots on the surface of the part, occurring after the article has been removed from the tool.

This suction pressure, combined with the normal contraction forces acting on the component, will tend to draw downwards the very thin shell of material at the surface immediately above the air void. Thus a sink or depression will be caused, and this area will be liable to develop cracks, owing to the fact that "set" of the material will be well advanced and thus its freedom to deflect in that manner will be greatly restricted.

The correction of this trouble will lie in ensuring quick evacuation of air from the cavity, by better situation or enlarged capacity of air-vent channels.

Gases may be generated within the cavity by the burning of lubricants or pigments in the charge, if the mould or material temperatures are too high.

8. *Sticking of component in the mould.* Surface cracks may also be produced because of excessive sticking tendencies of the moulding, a common trouble, arising from any of the following conditions.

8a. Overheated cavity surfaces. This will delay setting of the material and the walls of the ejected article will be very soft and pliable. Permanent distortion and cracking may thus be caused when the article is stripped from the cores.

One of the simplest correctives is to remove the mould from the machine nozzle, open the blocks, and leave a few minutes until heat has radiated from the mould.

8b. Cavity surfaces roughened or fouled by dirt, scale, etc.

8c. Minute surface pitting, erosion, or roughened patches, resulting from chemical action between the injected material and the surfaces of the mould.

8d. Slight damage and surface defects, such as burrs, nickings, abrasions, and

scratches on the plated or polished surfaces of the cavity walls and cores.

8e. Undercut portions at some point in the cavity formation, or upon the sides of core plugs. Such undercutting may be due to inaccurate machining and finishing of mould elements, wear and damage in use, or sinking or partial collapse of some unduly thin wall immediately behind the cavity.

This latter condition denotes use of a poor-quality mould steel, improper heat treatment, or unnecessarily weak mould construction.

8f. Use of metallic insert components which have to be moulded in the article. These may have to be located within a recess housing, or upon a peg, or by some other means incorporated in the mould cavity. By reason of dimensional errors and variations, or flashings permitted on these inserts, they may be caused to bind upon their supporting pins, etc., thereby producing misaligned ejection of the finished component.

Unsuitable component and mould design forms, such as uneven wall sections, poor location of cores, insufficient "draft" on cores and cavity walls, lack of strengthening ribs and blending fillets between disproportionate sections, and use of metallic inserts inaccurate in size or badly finished, etc., all lead to increased tendency towards sticking, distortion and cracking. Most of these features can best be avoided by the selection of superior design forms for both component and mould.

A component may be moulded under any of the unsuitable conditions described above, having its walls unduly distorted or warped, but showing no signs of cracks. However, cracks might develop later when the moulding is exposed to stresses involved in its service use. Such cracks may not denote an inherent weakness of the component design, but will be a secondary effect of distortion and stretching, and severe internal stresses occurring during moulding, the elimination of which would ensure a sound moulded article being produced.

(k) Porosity and spongy internal structure

Fortunately this kind of irregularity arises infrequently, and then only in connection with certain qualities of thermoplastic material. Usually it will be associated with components of a complex configuration, necessitating a very tortuous flow of material within the cavity.

Porosity is likely to occur in one of the two following forms, viz., trapped-air or gas porosity, and shrinkage porosity.

An account has already been given of the manner in which cracks arise from trapping of tiny pockets of air, or generated gas within the flowing material in the cavity before setting has occurred. Sometimes, however, the cracks may be absent and from a cursory visual examination the moulding may appear quite satisfactory and sound. Analysis of its internal wall structure at specific points, however, may reveal a number of tiny voids situated close to each other so as to form a spongy spot.

Usually with trapped-air or gas porosity there will be several small voids, or one large void surrounded by a number of much smaller ones. Each will be more or less regular in shape, generally globular, and have fairly smooth surfaces. Such a porous patch will tend to occur in the same position on successively moulded components. Porosity of this kind will mostly be found in the interior of thick wall structures.

Under certain operating conditions and with specific grades of material, gas or fume may be generated in the mould cavity, due to an unduly overheated mould, for example. Unless the air-vent channels are properly situated relative to the cavity configurations and the direction taken by the main portion of the flow therein, some of this gas may easily collect in isolated, remote or enclosed pockets to become entrapped in the charge.

These conditions can be corrected by more efficient venting of the mould to provide simpler means for the expulsion of air or gas; the relocation of the gate to alter the direction of flow throughout the cavity, and also to increase injecting pressure so as to ensure quicker fill of the cavity.

Shrinkage porosity. Voids and porous spots may sometimes be formed in the internal wall structure because of excessively unequalized shrinkage occurring between thick and thin wall sections of the part.

When a material is injected into the mould, immediately it comes into contact with the much cooler surfaces a decrease in volume will occur due to the contraction of the cooling material.

The layers of material in contact with the mould surfaces will, of course, shrink and set first.

The rapidity with which this decrease in volume takes place is related to the composition of the material, the injecting temperature, the temperature of the mould and, to some extent, the injecting pressure.

Unless such shrinkage can be compensated by an additional supply of fluid material, porosity or voids may be caused.

If the gate is too restricted in size and capacity, or too remotely situated relative to thick wall sections in the cavity, the additional material to compensate for the normal shrinkage cannot be drawn from the material in the gate—which remains hot and fluid longest—but must be drawn, wholly or in part, from portions of the components which have not yet become completely solidified. Since the outer layers of the component will already be well advanced in the "set," any material drawn therefrom will issue from the inner core, and as a result voids or porous spots may be caused.

Shrinkage of this kind usually creates one large void, irregular in shape, and with rough and jagged surface, which will usually be accompanied by a pronounced surface sink or depression.

The porous void will, of course, seriously weaken the wall. Like trapped-air porosity, shrinkage porosity is normally hard to detect by a mere visual examination.

This fault can be eliminated by drastically changing the moulding conditions, or by alternating the design of the component and the mould in order to ensure either a more effective feeding of that portion of the cavity where the greatest amount of shrinkage takes place or, alternatively, to remove that area of excessive contraction altogether. These areas will mostly be situated where there is a sudden and substantial change in the wall-section thickness, where the thin-walled section will "set" first and tend to draw material away from the soft inner core of the thicker section, leaving a void.

Localized overheated areas in the mould cavity wall surfaces also will retard the setting of the adjacent material, making these portions liable to be drawn off to satisfy shrinkage in other portions.

This can usually be modified or eliminated by adjusting or relocating the water-cooling channels, by altering the air-venting channels, or by re-gating the cavity at a different point. Decrease of the velocity of the material flow can also help.

Each material has its own characteristic degree and rate of contraction, first whilst it cools in the fluid state, then whilst it sets to the solid, and finally as it cools to room temperature. These three phases of shrinkage are important. Materials prone to great shrinkage will naturally present most difficulties, in neutralizing their proclivity towards shrinkage porosity, surface sinking, cracking, and similar physical weaknesses. These materials would, therefore, not be employed for precision-type mouldings, or for those having to withstand substantial loading and stressing during service.

When any particular thermoplastic material tends to contract considerably in the first phase of cooling, this will impose certain limits on the temperatures employed when actually injecting into the mould.

A high rate of shrinkage in this phase may, therefore, prove disadvantageous by creating a certain degree of unbalance in respect of mould and material temperatures. On the other hand, a thermoplastic material possessing a high rate of shrinkage from the fluid to the solid condition, and from the latter to room temperature, may give rise to other objections.

With such a material the mould designer may experience some difficulty in fixing the amount of compensating allowance to be provided on critical dimensions of the cavity to offset contraction.

(l) Uneven shrinkage effects

In view of the numerous references already given to the undesirable conditions and irregularities caused by uneven contraction of non-uniform wall sections, etc., little more than a few general points need be discussed at this late juncture.

Degrees of contraction envisaged by the mould designer, or the direction in which major shrinkage will take place, may often be altered by the presence of cores, cavity wall, projections, the relative thickness of base walls of the article, the amount of draft permissible on cores, the extent to which slender and very thin portions are to be cored, the depth of coring, the size and type of inserts, and so forth.

Each or all of these elements may give rise to working conditions not anticipated during mould design, and may result in puzzling shrinkage effects on the finished component. The more complex the configuration of a component, the greater the risk of unexpected shrinkage effects, and the more problems which may be raised when the tool is put into production.

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		THERMOCHROM CRAYONS (TEMPERATURE INDICATORS)	Temperature indicators for machinery heating systems, etc. Rapid and distinct colour change.
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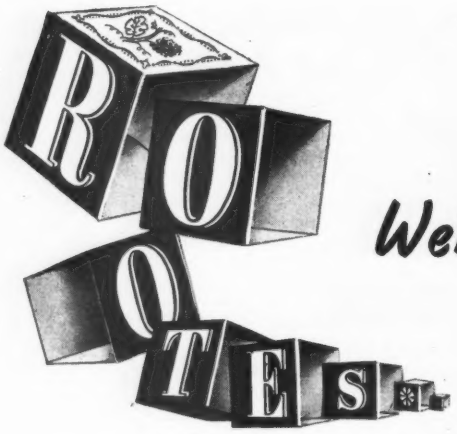

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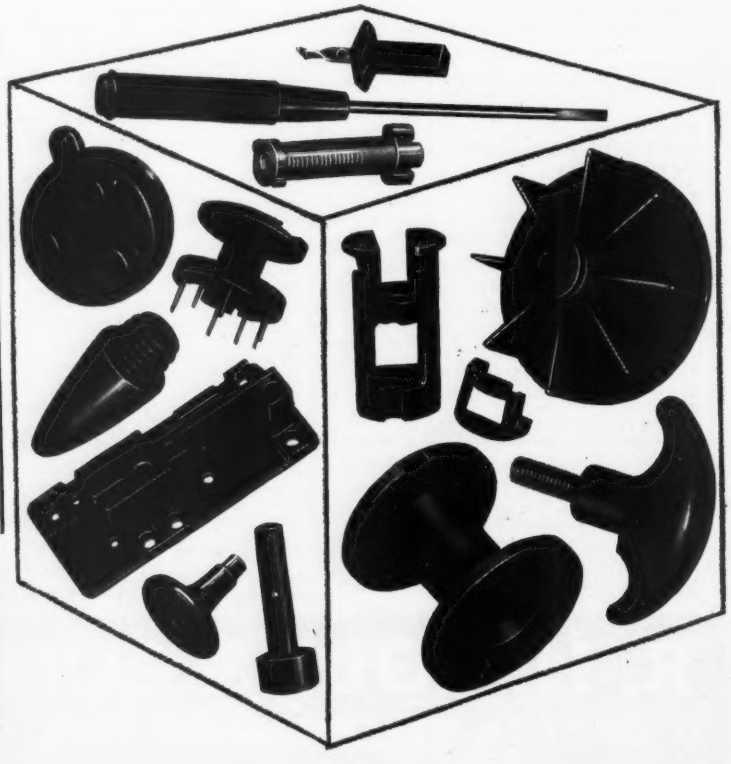

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PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. The country of origin for Convention Applications is shown in parentheses. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 2s. 8d. each (including postage).

B.P.675,165. Esterification of synthetic resinous polyhydric alcohols. S. O. Greenlee. To: Devoe and Raynolds Co. (U.S.A.).

B.P.675,168. Manufacture of epoxide resins. S. O. Greenlee. To: Devoe and Raynolds Co. (U.S.A.).

The products obtained by reaction of dihydric phenols with more than the equivalent proportion of polyepoxides are valuable in the manufacture of varnishes, moulding compositions, films and moulded articles.

B.P.675,169. Synthetic resins obtained by condensation of polyhydric phenol and halogenhydrins. S. O. Greenlee. To: Devoe and Raynolds Co. (U.S.A.).

B.P.675,169. Synthetic resins obtained by condensation of polyhydric phenols and epichlorhydrin. To: Devoe and Raynolds Co. (U.S.A.).

B.P.675,180. Epoxide compositions. C. E. Bixler. To: Devoe and Raynolds Co. Inc. (U.S.A.).

The compositions show i.a. good adhesion to metal, glass, wood, filaments, fibres, etc., and are useful for making laminated or moulded articles.

B.P.675,189. Integral brush assembly. C. E. Bixler. To: Devoe and Raynolds Co. Inc. (U.S.A.).

The bonding compositions comprise phenol and two epoxide containing components.

B.P.675,205. Driving and like belts. E. Siegling.

A polyamide or like plastic layer is reinforced by transverse threads cemented by a liquid plastic of a similar nature to the plastic layer.

B.P.675,207. Production of deep embossed effects on fabrics. C. A. Redfarn.

Cloth impregnated with an alcohol-modified melamine-formaldehyde resinous syrup is embossed between a pattern-carrying heated metal roll and a mating cotton coated roll.

B.P.675,251. Stabilization of polymeric vinylidene cyanide. To: B. F. Goodrich Co. (U.S.A.).

B.P.675,278. Gelling agents for vinyl polymers. C. Jahn (Switzerland).

B.P.675,364. Optical projection system, particularly for stereoscopic pictures, and screen therefor. E. G. Beard (Australia).

The screen may be made, if desired, of transparent plastics

B.P.675,372. 2, 3—Difluoro—1, 3, Butadiene, its polymers and copolymers and the preparation thereof. P. A. Wiseman. To: Firestone Tyre and Rubber Co. Ltd. (U.S.A.).

B.P.675,377. Varnish on the basis of polyvinyl resins for enamelling. To: British Thomson-Houston Co. Ltd. (France).

B.P. 675,397. Polymeric vinyl ethers and process of producing them. To: Badische Anilin- and Soda-Fabrik (I. G. Farbenindustrie A.G.) (Germany).

B.P.675,405. Stabilization of halogenated organic products against heat and light deterioration. To: N. V. de Bataafsche Petroleum Maatschappij (U.S.A.).

The stabilizer is a certain glycidyl ether and a carboxylic acid salt of strontium or cadmium.

B.P. 675,421. Illumination of the ciphers exhibited through the dials of meters and other indicating instruments. U. Nistri (Italy).

An apertured sheet of methyl methacrylate is placed between covering glass and dial.

B.P.675,433. Interpolymers. To: United States Rubber Co. (U.S.A.).

The polymeric materials are derived from di-2-alkenyl citraconates and/or mesaconates. Conversion without danger of gelation is obtained by co-polymerization with a certain 2-alkenyl alcohol or chloride. The inter-polymers admixed with solvents, dyes, plasticizers, pigments, fillers are useful in moulding, coating, impregnating with minimum shrinkage.

B.P.675,452. Methods of glossing paper. T. A. Clayton. Comm. from: United States Rubber Co.

A resinous copolymer of styrene and acrylonitrile (65-80 per cent. and 35-20 per cent.) is applied in an aqueous dispersion while the paper is in contact with a mirror-finished roll under heat and pressure.

B.P.675,474. Buttons. A. E. Sutin.

A button head with projecting socket neck into which a peg fits is moulded (machined) from plastic material.

B.P.675,475. Production of Moistureproof film. W. Berry, C. R. Oswin, E. G. Sanderson. To: British Cellophane Ltd.

B.P.675,477. Production of aqueous dispersions of cationic particles of urea-formaldehyde resins. W. Berry, C. R. Oswin, E. G. Sanderson. To: British Cellophane Ltd.

B.P. 675,489. Manufacture of novel polymeric products. Dunlop Rubber Co., F. A. Jones, W. Cooper, T. B. Bird.

B.P.675,508. Floor covering. T. T. Clarke. To: Wallington, Weston and Co. Ltd.

An upper wearing surface of polyvinyl chloride, a polyvinyl ester or a copolymer of vinyl compounds is attached to a layer of rubber.

B.P.675,547. Process for improving the properties of polymerization products from styrene. To: Badische Anilin- and Soda-Fabrik (I. G. Farbenindustrie A.G.).

The polymerisates are treated in comminuted state at 100 deg. C. with steam to remove constituents volatile in steam.

B.P.675,575. Coating compositions. J. C. Gourlay, F. W. Hobden, I.C.I. Ltd.

High gloss finish is produced from compositions based on an emulsion of a particular alkyd resin.

B.P.675,580. Melting apparatus for materials such as resins, cellulose acetate and the like. I. C. Morgan, S. Bromley.

Steam is passed through a column of trays with strainer bottoms with deflectors under the trays and a collector for the melted material.

B.P.675,581. New octyl phthalate and vinyl resins plasticizer therewith. Distillers Co. Ltd., K. H. W. Turck.

B.P.675,627. Compositions containing organic polymers and a process of producing them. To: Badische Anilin-and Soda-Fabrik (I. G. Farbenindustrie A.G.) (Germany).

The high polymer organic substances is a vinyl chloride polymer or copolymer.

B.P. 675,652. Machines for moulding plastic materials. To: Crown Machine and Tool Co. (U.S.A.).

The plasticizing of the material injected into the mould is improved by a gradual increase in volume of the plasticizing chamber from the point where the granules enter to the point where they become a viscous fluid to be directed into the injection cylinder.

B.P. 675,663. Manufacture of composite sheet material. Dunlop Rubber Co., Ltd., W. H. Hogg.

A mixture of a fibrous filler, discrete particles of a polyvinyl resin and an ester plasticizer are spread on a polyvinyl resin sheet and heated so that the mixture coalesces. The hot layer is then compressed and bonded to the sheet. The sheet may also be polyvinyl chloride with corresponding particles and plasticizer in the mixture.

B.P. 675,665. Production of polymeric compounds. Courtaulds, Ltd., A. S. Carpenter, E. R. Wallsgrove.

B.P. 675,673. Manufacture of artificial resins, and coating compositions, particularly for coating regenerated cellulose films. W. Berry, C. R. Oswin, E. G. Sanderson. To: Brit. Cellophane, Ltd.

B.P. 675,679. Phonographic record and method of manufacturing the same. To: Soc. des Arts et Sciences Appliqués (France).

The plastic sheets carrying the sound grooves (upper and lower sheet) have a size slightly less than the completed record. An image-carrying plaque is of slightly less size than the sheets, and the core is formed with a shallow dish and an upstanding double shoulder embedding the plastic sheets and protecting their edges.

B.P. 675,686. Manufacture of artificial tubular packing materials. W. Berry, C. R. Oswin. To: Brit. Cellophane, Ltd.

The casing (extruded viscose) is provided with tearing lines.

B.P. 675,695. Method of and means for moulding and curing plastic compounds. To: Wingfoot Corp. (U.S.A.).

The material is introduced between the mould parts in the separation plane. On closing the mould, the displaced material flows into the adjacent mould cavity. Only a minimum of trimming is, therefore, required.

B.P. 675,764. Film-forming and adhesive compositions, method of making the same and method of forming continuous films. I. V. Wilson. To: Monsanto Chemical Co. (U.S.A.).

The films are formed from a dispersion, e.g., polystrene prepared by emulsion polymerization of styrene monomer, water (as the continuous phase) and a solvent of boiling point higher than water.

B.P. 675,783. Manufacture of copolymers. British Oxygen Co., Ltd., J. W. Haworth.

Vinyl acetate is copolymerized with triallyl phosphate in the presence of a catalyst (peroxides, persulphates).

B.P. 675,805. Magazines for safety razor blades. To: Gillette Safety Razor Co. (U.S.A.).

The casing may be moulded from cellulose acetate, "Vinylite," "Bakelite" or the like.

B.P. 675,808. Children's toys. Universal Injection Plastics, Ltd., J. Johnston.

Toy has form of an electric shaver with transverse roller.

B.P. 675,818. Moulding compositions containing cellulosic filler. To: American Viscose Corp. (U.S.A.).

A filler of 10-50 parts alpha-cellulose and 90-50 parts regenerated or alkali-soluble cellulose is impregnated with urea-formaldehyde or urea-melamine-formaldehyde resin precondensate (60-70 parts resin to 40-30 parts filler).

B.P. 675,823. Thermosettable resins. To: Westinghouse Electric International Co. (U.S.A.).

A binder for mica flakes is composed of acrylonitrile, styrene, maleic anhydride, diallyl phthalate refluxed in an organic solvent.

B.P. 675,839. Self-adhesive tapes. C. Koenig (Germany).

A reinforcing filament is placed in a longitudinal groove of tape coated with an adhesive. Indentations on both sides prevent continuous surface contact of adjacent layers.

B.P. 675,903. Process of tempering curved glasses of organic polymeric materials. To: Lonza Elektrizitaetswerke und Chemische Fabriken A.G.

A watch glass in a frame is heated on the convex side and simultaneously cooled on the concave side.

B.P. 676,006. Methods of mixing polyethylene with asphalt bitumens. To: N.V. Philips' Gloeilampenfabrieken (Netherlands).

B.P. 676,011 Modified aminoplasts and products prepared therefrom. H. P. Wohnsiedler, E. L. Kropa, W. M. Thomas. To: British Industrial Plastics Ltd. (U.S.A.).

Certain linear reaction products, which are aldehyde reactable and can be inter-condensed, are employed and result in new compositions for moulding, impregnating, as adhesives, for laminating fibrous sheets under heat and pressure.

B.P. 676,017. Hoods or covers for children's perambulators or the like. D. W. Payne, J. Bewley.

The hood is moulded in parts from "Perspex" and may have coloured decorations.

B.P. 676,030. Digits for vehicle registration number plates. F. W. Bluemel. To: Bluemel Bros. Ltd.

The digit is moulded in white plastics with a groove for a light-reflecting metal insert.

B.P. 676,122. Process for preparing transparent phenol-formaldehyde resins. To: Stalinovy Zavody n.p. (Czechoslovakia).

Diallyl phthalate is added to a novolak as a plasticizer. High impact resistance and high resistance to pressure is obtained.

B.P. 676,175. Device to be worn on the head and manufacture thereof. K. P. Jensen, P. L. Thomsen (Denmark).

A pad for hairdressing or a support for headscarves is wound from plastics thread (nylon).

B.P. 676,179. Ornamented lampshades. M. B. Prichard, M. W. Pratt.

Plastics three dimensional models are cemented to facets in wire frame.

B.P. 676,181. Vent cap for storage batteries. T. L. Kendall. To: General Motors Corp. (U.S.A.).

Cap and valve are fabricated from polyethylene, used without gasket, with apertured closure plates of polystyrene snapped into grooves.

B.P. 676,187. Drinking tubes. C. D. Waller.

A child's "Alkathene" drinking tube has a moulded plaque (animal or other figure) attached to it.

B.P. 676,228. Reinforced plastics tapes for Venetian blinds. A. H. Stevens. Comm. from: Hunter Douglas Corp.

B.P. 676,280. Suspensions of polymeric chlorotrifluoroethylene. To: British Thomson-Houston Co. Ltd. (U.S.A.).

A stable uniform suspension is obtained by mixing the finely divided (in micropulverizer) polymer with a chlorinated organic ether and finely grinding this mixture.

B.P. 676,300. Plain bearing or the like. Glacier Metal Co., Ltd., W. H. Tait.

A synthetic polyamide resin compound (nylon) powder (1 part) and silver (5 parts) are mixed, cold-pressed, sintered, and hot pressed into final shape, e.g. into a self-lubricating bush or half bush. The method may be carried out on a silver plated steel or bronze backing for the production of composite bearings.

B.P. 676,304. Shaving brush. V. C. E. Marten-Gwilliam.

B.P. 676,315. Translucent cinematograph projection screens. B. V. Bowden, H. McG. Ross, F. P. Gloyns. To: J. Arthur Rank Productions Ltd.

A thinned ethyl cellulose solution is sprayed on to a plaster ceiling in several layers with one or more intermediate plastics layers loaded with crushed or powdered glass of a refractive index of preferably 1.65.

B.P. 676,325. Extruding devices for thermoplastic materials and the like. L. M. H. Kraffe de Laubarede. (France.)

The material progressively heated during travel to the compression chamber tends to develop gases impairing homogeneity. This can be overcome by feeding screws with notches in a portion of their length so that gas produced can escape in a direction opposite to the feed.

B.P. 676,335. Respiratory device. R. A. Berman (U.S.A.).

A polyethylene airway for insertion in mouth or pharynx is either injection or compression moulded or extruded (preferably) in the form of an H-bar, then cut and slit, heated and shaped.

B.P. 676,376. New polymerizable compounds and polymers thereof. Distillers Co. Ltd., D. Faulkner, C. E. Hollis, J. N. Milne.

The new compound is paravinyl benzamide, the polymeric material comprises N-methylol paravinyl benzamide units and copolymers with styrene. Hard transparent glassy resins are obtainable for foils, films, fibres.

B.P. 676,381. Thermoset resinous bodies. To: Westinghouse Electric International Co. (U.S.A.).

A composition of (a) 70 to 97 per cent. by weight of a partially reacted aqueous reaction product of a phenol and an aldehyde, (b) 5 to 0.1 per cent. of a surface-active foam-producing agent, (c) 25 to 1 per cent. of at least one peroxide of a group of peroxides (calcium, sodium, magnesium, etc., peroxide) adheres tenaciously to metals and plastics. The cellular compositions are further useful for structural members of great strength for a given weight (aircraft, non-sinkable boats, etc.).

B.P. 676,412. Automatically operating hydraulic presses for the moulding of thermosetting plastics. E. Menzel.

One end of each mould cavity of a set of moulds is closed by pressure pistons, the other end by the displacement of the moulds so that they engage cores carried on a cross member. On retracting the moulds, the moulded pieces remain on the cores and may then be removed or checked before the next moulding cycle starts.

B.P. 676,433. Cutting pads. A. R. Olson, E. W. Gelewitz. To: Brit. United Shoe Machinery Co. Ltd.

Cutting out shoe uppers on a pad of a clicking press by a die requires certain hardness and wear resistance of the pad such as maple wood, which is now in short supply. A thermosetting composition of 100 parts of a butadiene-acrylonitrile (20 per cent.) copolymer and of 80 to 105 parts of certain "Durez" resins has been found suitable.

B.P. 676,439. Knob mountings. Evered and Co. Ltd., A. Taylor.

A hardened ball is interposed between a thermosetting-plastics knob and the upper end of a screw-spindle mounting to admit free rotation of the knob around the spindle.

B.P. 676,447. Film-forming organic materials. To: Badische Anilin- and Soda-Fabrik (I. G. Farbenindustrie A.G.) (Germany).

Corrosion effects, in particular on iron, can be overcome by the addition of 0.05 to 3 per cent. of triply unsaturated hydroxy compounds. Non-corrosive steels are then not essential any more for rollers and moulds in which polymers are processed.

B.P. 676,469. Toy building blocks. Die Casting Machine Tools Ltd., A. R. Mills.

The blocks may be moulded from plastics or die-cast.

B.P. 676,510. Self-cleaning air filter. W. M. Sheldon. To: Pulverizing Machinery Co.

Impregnation of felt with a small amount of a synthetic resin (polyvinyl chloride or similar resins) greatly reduces stretch under tension or shrinkage.

B.P. 676,536. Injection moulding apparatus. Brit. Moulded Plastics Ltd., G. W. E. Parnell.

A compression moulding machine may be combined with an injection machine by adapting the mould normally used in the moulding machine to be fed by the injection machine, which may be mounted on wheels.

B.P. 676,543. Moulding and jointing of thermoplastic materials, for example, in the jointing of electric cables. A. A. W. Barnes. To: Telegraph Construction and Maintenance Co. Ltd.

A continuous stream of hot air or nitrogen is passed through the mould interior to heat the two ends in the mould. The joint is completed by introducing jointing material in plastic condition.

B.P. 676,559. Adhesive tapes. To: Johnson and Johnson (Gt. Britain) Ltd. (U.S.A.).

A flexible interliner film, comprising a major proportion of polyethylene, is removably attached to the adhesive coating on a flexible backing.

B.P. 676,580. Polymerization method. C. H. Basekis, G. L. Wesp. To: Monsanto Chemical Co. (U.S.A.).

Uniform fibre-forming copolymers of acrylonitrile and a polymerizable basic monomer (vinyl monomer substituted with a basic amino group) are obtained by the aqueous dispersion technique.

B.P. 676,585. Treatment of polyamides. To: Inventa A.G. für Forschung und Patentverwertung (Switzerland).

B.P. 676,597. Solutions of polymeric chlorotrifluoroethylene. To: Brit. Thomson-Houston Co. Ltd. (U.S.A.).

B.P. 676,602. Injection moulding machines. To: (F.I.M.S.A.) (Italy).

The plastics powder or granules are conveyed from the bottom of a hopper laterally by a worm (tubular grooved surface), which is surrounded by a heating device, into an injection chamber with a valve opened by being moved into engagement with the mould.

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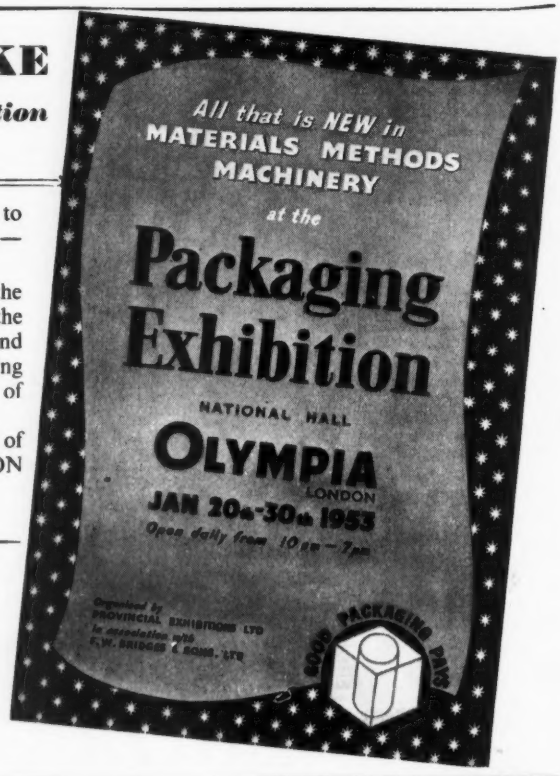

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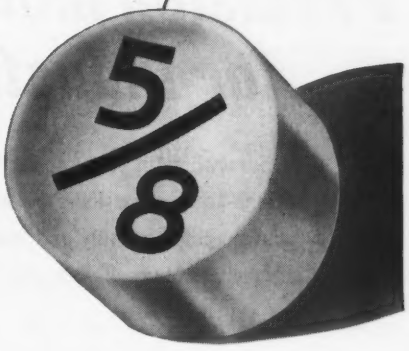

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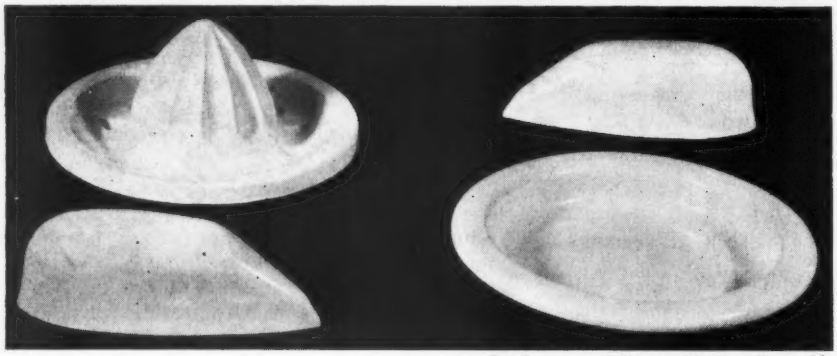

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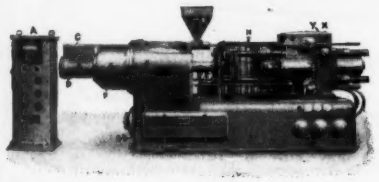

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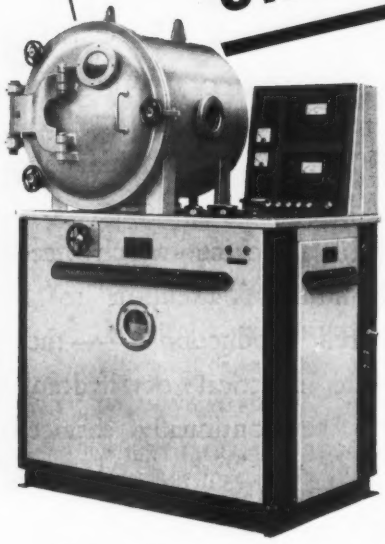

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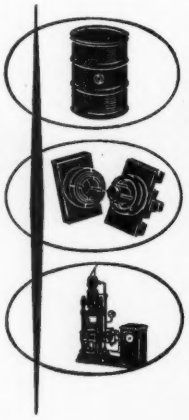

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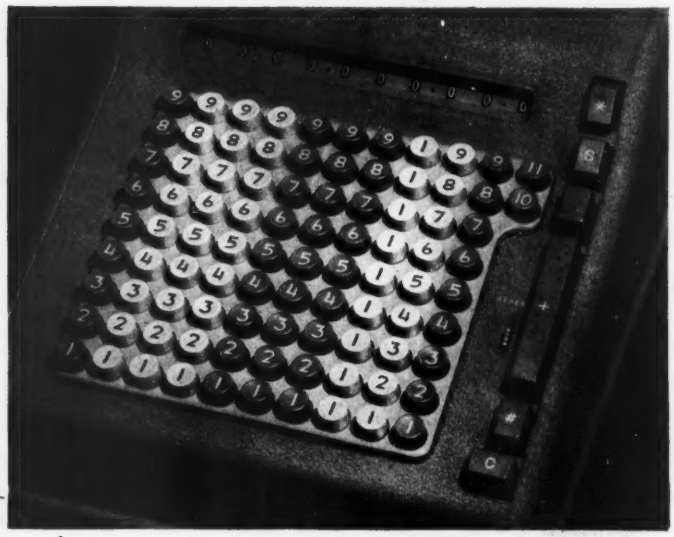

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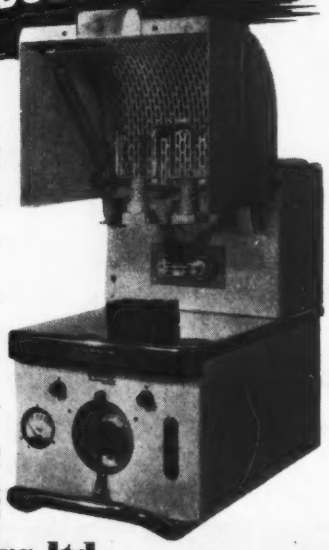

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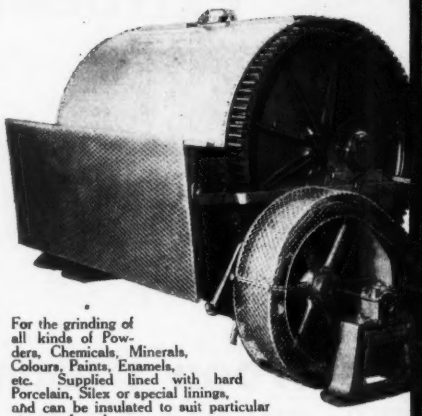

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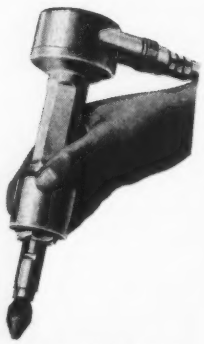

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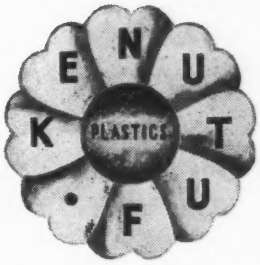

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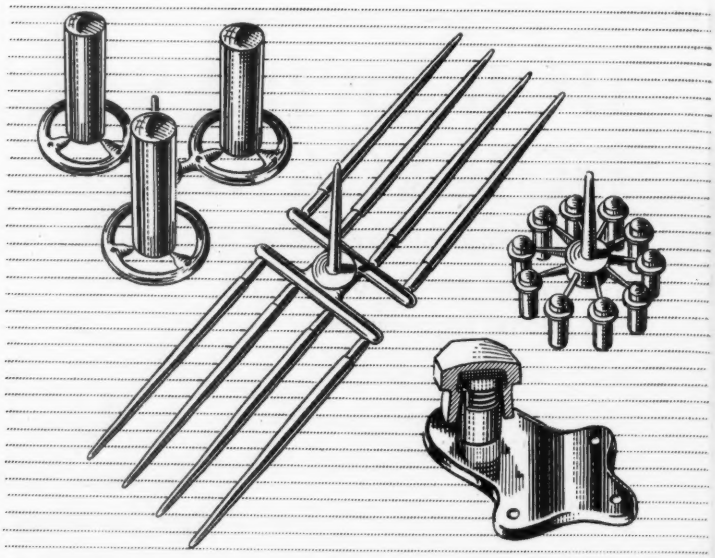

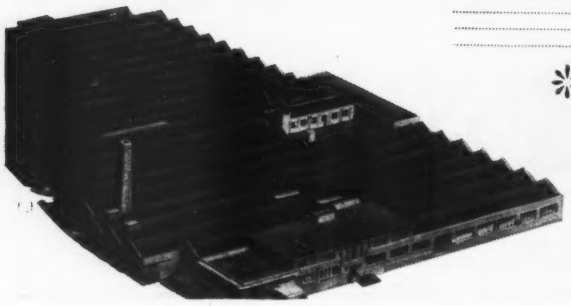

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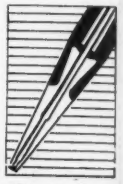

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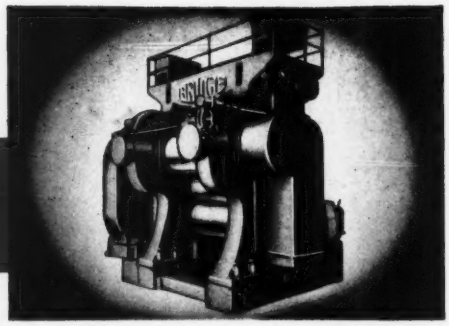

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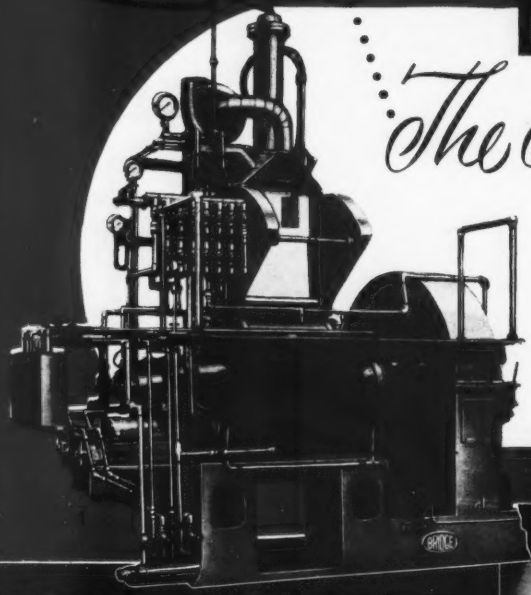

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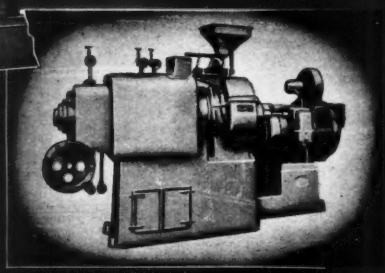

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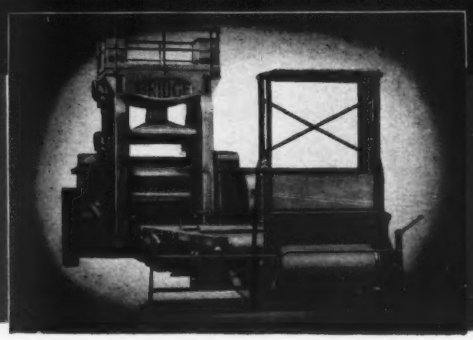

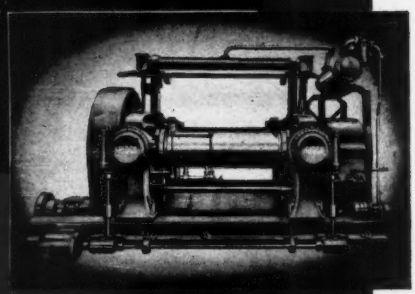

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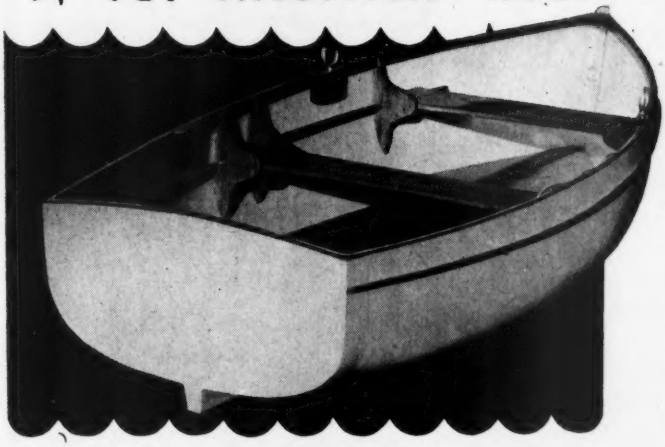

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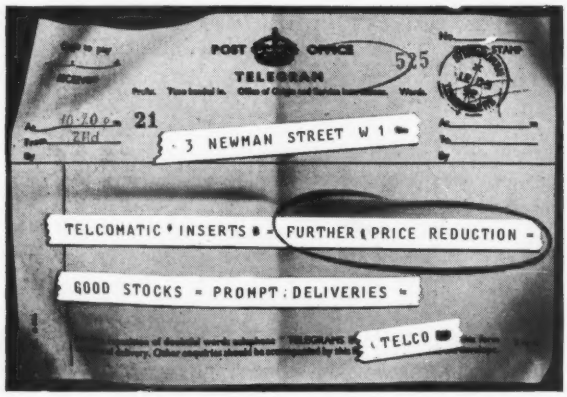

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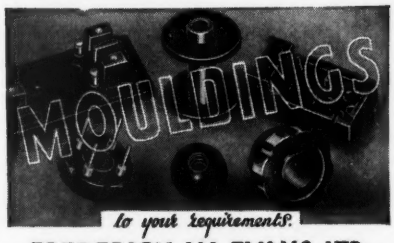

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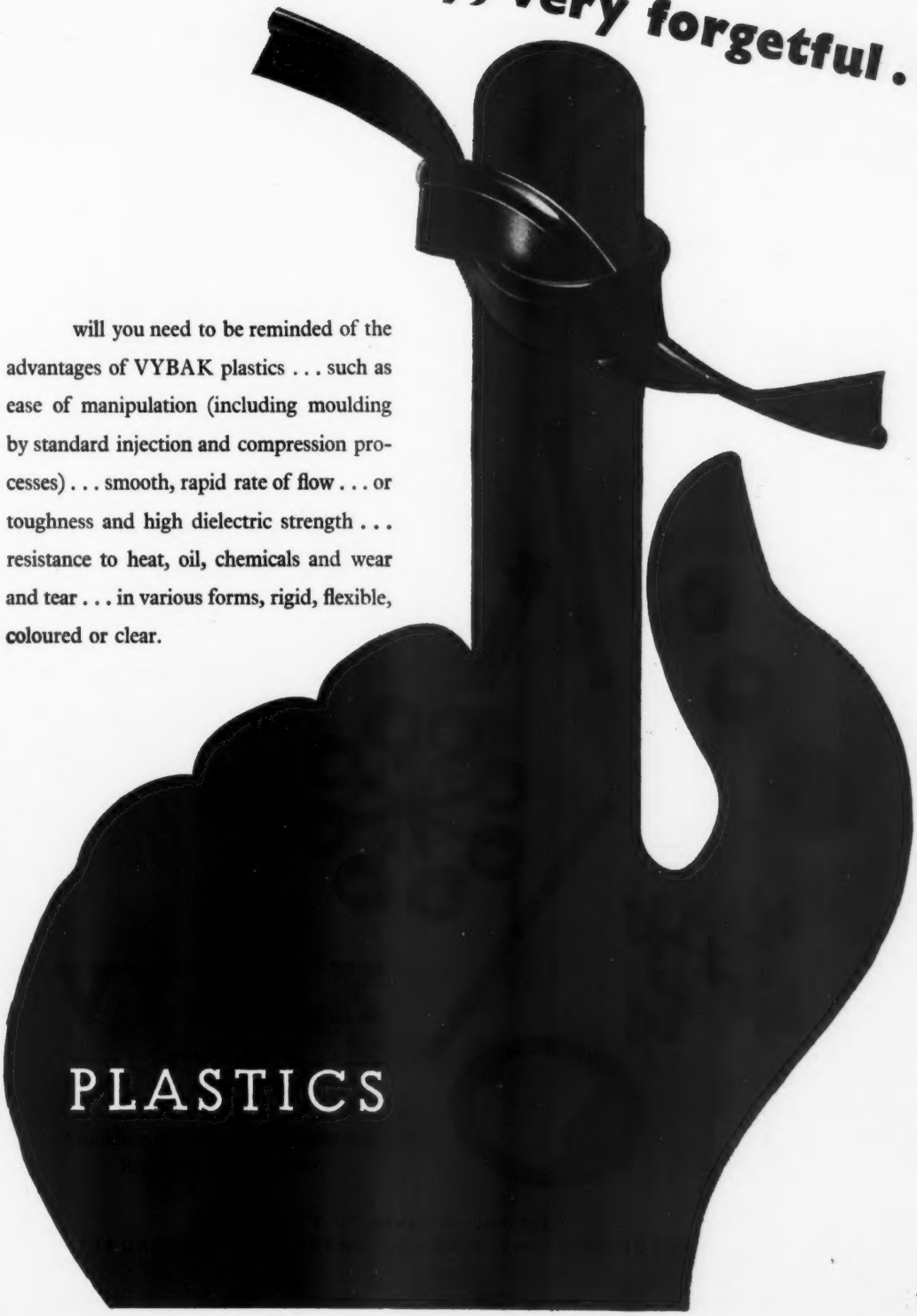

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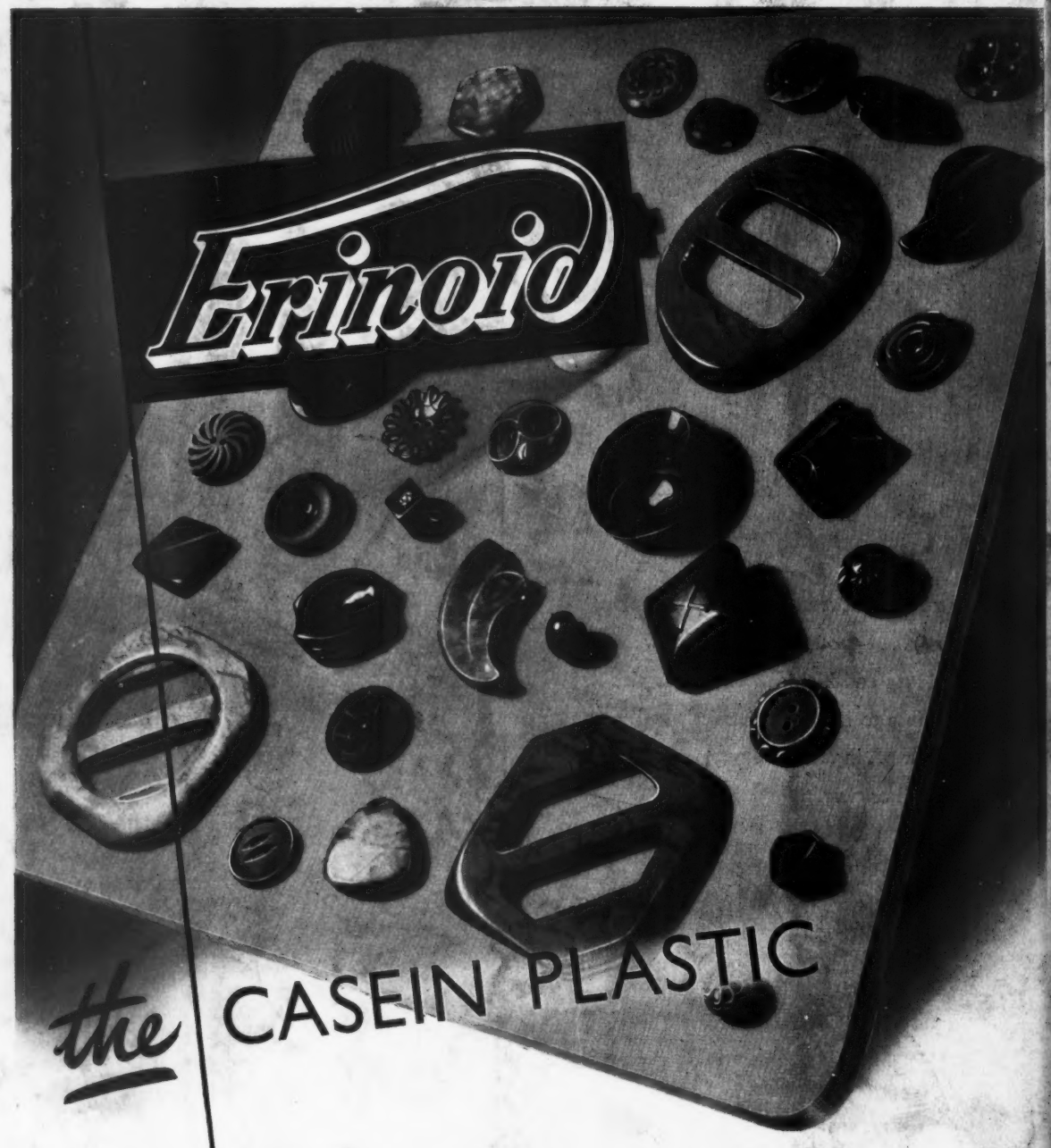

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